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The Engineer

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TECHNICAL COLLEGE, BRADFORD.

Full-time Day Courses are arranged to meet the needs of Students wishing to present themselves for the Degree Examinations of the London University in

MECHANICAL ENGINEERING,
CIVIL ENGINEERING,
ELECTRICAL ENGINEERING.

Further particulars and prospectuses may be obtained on application to THE PRINCIPAL, TECHNICAL COLLEGE, BRADFORD. 2978

PUBLIC NOTICES

The Director-General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
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2. 10,800 PLATE-LAYERS', FIRING and COAL SHOVELS.
3. 15 SETS MANGANESE STEEL SWITCHES and CROSSINGS.
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6. 102 COPPER FIRE-BOX PLATES for Locomotives.
7. 1000 CAST STEEL AXLE-BOXES for Engines.
8. 2700 STEEL FLUES for Loco. Superheaters.
9. COMPENSATORS, JOINTS, SEGMENTS, &c., for Railway Signals.
10. VALVES, PISTON-RODS, &c., for Vacuum Brake Gear.
11. 777 STEEL TYRES for Engines and Tenders.
Tenders due on the 24th August, 1926, for Nos. 1 and 2; on the 27th August, 1926, for Nos. 3 to 9; and on the 31st August, 1926, for Nos. 10 and 11.
Specifications and forms of Tender obtainable from the above at a fee of 5s. per set, which is not returnable. 3062

Assistant Engineer Required by the GOVERNMENT of KENYA, for a tour of 20 to 30 months' service. Salary £650 a year, free quarters and passages, and liberal leave on full salary. Candidates, aged 30 to 40 years, must be fully qualified Civil Engineers, who have had good experience in Municipal and Waterworks Engineering.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,624. 3063

Assistant Engineers (6) REQUIRED by the GOVERNMENT of NIGERIA for the PUBLIC WORKS DEPARTMENT for two tours of not less than 12 nor more than 18 months' service in the first instance. Subject to satisfactory service the officers appointed will be eligible at the expiration of three years' service for confirmation in the permanent and pensionable establishment. Salary £480, rising to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates, preferably between 25 and 30 years of age, unmarried, must have passed the examination for A.M.I.C.E. or possess a degree in Civil Engineering recognised by the Institution as exempting from Parts "A" and "B" of the examination. They must have had proper technical training and preferably have had not less than two years' subsequent experience on large Engineering or Municipal Works. Candidates possessing other civil engineering qualifications may apply.—Applications should be made at once by letter, stating age, qualifications and experience, also whether married or single, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, London, S.W. 1, quoting M/14485. 2984

Civil Engineers Required for service in the IRRIGATION and PUBLIC WORKS DEPARTMENTS of IRAQ for two to three years of probationary service in the first instance, with prospect of extension for ten years' service. Free passages and liberal leave on full salary.
M/14691.—ASSISTANT ENGINEERS (3) for the Irrigation Service. Salary Rs. 450, rising to Rs. 800 a month by annual increments of Rs. 50 a month. Candidates, preferably between 23 and 28 years of age, unmarried, should have passed the A.M.I.C.E. examination, have been educated at one of the leading Universities and had one or two years' practical experience since obtaining degrees.
M/14744.—ASSISTANT ENGINEER (1), to act as Engineer Manager of the Baghdad Water Board. Salary Rs. 800 a month, rising by annual increments of Rs. 50 a month. Candidates, aged 25 to 30, unmarried, should be Associate Members of the Institution of Civil Engineers, or possess equivalent professional qualifications, and have had experience of pined water supplies, water clarification and distribution, and a practical knowledge of Diesel engines. A knowledge of electrical work would be of advantage, but is not essential.—Apply at once by letter, stating age, qualifications and experience, and quoting clearly the reference number of the appointment for which application is made, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1. 3022

Draughtsmen, Mechanical and ELECTRICAL, REQUIRED. Candidates must have shop training, 5 years' drawing-office experience with public works contractor or consulting electrical engineer, experience in lay-out small power-houses, pumping installations, electric distribution mains and water mains. Experience design of switchboard and switchgear desirable.
Salary £140-10-£200 a year plus Civil Service bonus (gross salary £225-£308). Preference ex-Service men. Apply, SECRETARY (W.B. 5), Air Ministry. 3031

Safety in Mines Research BOARD.
RESEARCH APPOINTMENTS.
The Safety in Mines Research Board REQUIRES a RESEARCH ASSISTANT for work in connection with Colliery Wire Ropes and a JUNIOR RESEARCH ASSISTANT for work on Materials and Structures used for the Support of Underground Workings. Applicants must possess good scientific qualifications, including a University degree (or its equivalent) in Engineering, have a good knowledge of testing materials and be good draughtsmen, but special knowledge of metallurgy is not required. For the senior post previous research experience is necessary.
Preference will be given to ex-Service candidates.
Scales of salary: Assistant, £250 x 15-350; Junior Assistant, £160 x 10-190.
In addition a fluctuating cost-of-living bonus is payable, making the present minima of the scales £377 and £258 respectively.
The posts are whole-time ones, subject to the provisions of the Federated Superannuation System for Universities and tenable in London.
Forms of application, which must be returned not later than 25th August, can be obtained from the UNDER SECRETARY FOR MINES, Establishment Branch, Mines Department, Dean Stanley-street, London, S.W. 1. 3032

PUBLIC NOTICES

Ministry of Transport. ROADS DEPARTMENT. TEMPORARY ENGINEER.
APPLICATIONS are INVITED for a TEMPORARY APPOINTMENT as ENGINEER in London, at a salary £400 to £500 per annum inclusive.
Candidates with experience under County or Municipal Highway Authorities, and with practical experience of modern Road and Bridge Construction, are required, and preference will be given to men who have served in His Majesty's Forces.
Application should be made immediately, in writing, to the ESTABLISHMENT OFFICER, Ministry of Transport, 6, Whitehall-gardens, S.W. 1, stating age, qualifications, experience and references. 3051

Technical Officer—Grade II., REQUIRED, primarily for Design of Wireless Apparatus for Service Aircraft and Aerodrome use. Candidates should possess Honours Degree in Physics or Engineering and must have had at least 3 years' practical experience in a leading laboratory or firm engaged on wireless design and application, or work of an allied character. Candidates must also be medically fit for flying and willing to fly as observer. Commencing salary £250 plus Civil Service bonus, giving a present total starting remuneration of £377 per year on the scale £250-20-£350 plus Civil Service bonus. Preference given, other things being equal, to an ex-Service man.—Application should be made on a form to be obtained from the SUPERINTENDENT, Royal Aircraft Establishment, South Farnborough, Hants, to whom it must be returned, quoting reference No. A. 121, not later than 28th August, 1926. 3035

PUBLIC NOTICES

University of Birmingham.
FACULTY OF SCIENCE.
ENGINEERING DEPARTMENTS.
I.—MECHANICAL ENGINEERING.
"CHANCE" PROFESSOR: F. W. BURSTALL, M.Sc., M.A. (Cantab.), M.I. Mech. E.
LECTURER: R. C. PORTER, M.Sc. (Vict.), A.M.I.C.E.
DEMONSTRATOR: S. J. ELLIS, B.Sc., A.M.I.C.E.
LECTURER ON MACHINE DESIGN: P. H. BODEN, B.Sc.
ASSISTANT LECTURER ON MACHINE DESIGN: H. P. DEAN, B.Sc.
II.—CIVIL ENGINEERING.
"BEALE" PROFESSOR: CYRIL BATHO, M.Sc., D.Sc., B.Eng.
LECTURERS: R. C. PANTON, M.Sc., A.M.I.C.E. H. W. COULTAS, M.Sc., M.I. Mech. E. T. H. P. VEAL, B.Sc., A.M.I.C.E.
LECTURER ON TOWN PLANNING: W. HAYWOOD, F.R.I.B.A.
III.—ELECTRICAL ENGINEERING.
PROFESSOR: WILLIAM CRAMP, D.Sc., M.I.E.E.
LECTURERS: E. J. KIPPS, M.Sc., M.I.E.E. G. M. HARVEY, M.Sc., B.Eng.
ASSISTANT LECTURER: L. G. A. SIMS, M.Sc.
THE FULL COURSES EXTEND OVER FOUR YEARS, and students who enter after Matriculation and pass successfully the examinations at the end of each year will be ENTITLED TO THE DEGREE OF BACHELOR OF SCIENCE in Engineering.
THE SESSION 1926-27 COMMENCES ON OCTOBER 4th, 1926.
For detailed syllabus of the Faculty with full particulars of University Regulations, Lecture and Laboratory Courses, Fees, &c., apply to the REGISTRAR. 2943

PUBLIC NOTICES

EAST LONDON COLLEGE
(UNIVERSITY OF LONDON),
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The Royal Technical College, GLASGOW.
DEPARTMENTS OF ENGINEERING.
MECHANICS AND MECHANICAL ENGINEERING: Professor ALEXANDER L. MELLANBY, D.Sc., M.I. Mech. E.
Associate Professor WILLIAM KERR, Ph.D., A.R.T.C.
ELECTRICAL ENGINEERING: Professor STANLEY PARKER SMITH, D.Sc., M.I.E.E., A.M. Inst. C.E.
CIVIL ENGINEERING: Professor GEORGE MONCUR, B.Sc., M. Inst. C.E., M. Amer. Soc. C.E.
MINING ENGINEERING: Professor DANIEL BURNS, M. Inst. M.E.
CHEMICAL ENGINEERING: Professor of Technical Chemistry: THOMAS GRAY, D.Sc., LL.D., Ph.D., F.I.C.
Complete Courses of Instruction are provided, qualifying for the Diploma of the College and for the Degree of B.Sc. in Engineering of Glasgow University.
Composition fee 25 guineas per annum.
SESSION 1926-7 BEGINS on TUESDAY, SEPTEMBER 21st.
Calendar, by post, 2s., and prospectus, gratis, may be obtained on application to the DIRECTOR. 2848

The University of Sheffield.
SESSION 1926-27.
Vice-Chancellor: Sir HENRY HADOW, C.B.E., D.Mus., LL.D.
DEPARTMENTS OF MECHANICAL, ELECTRICAL, AND CIVIL ENGINEERING, METALLURGY, MINING, FUEL TECHNOLOGY, AND GLASS TECHNOLOGY.
The Courses in the above Departments extend over three or four years and prepare students to become specialists in one or other of these branches of Applied Science.
The LECTURE COURSES in all the Departments are supplemented by Practical Training in Laboratories and Workshops, which are fully equipped for the purpose of advanced scientific teaching, investigation and research.
Part-time Courses are arranged for students who desire to take special portions of any of the regular Courses.
In Mining Engineering and in certain of the Courses in Mechanical and Electrical Engineering, and in Glass Technology, arrangements are made to enable students who come to the University from works or collieries to take six months' Courses of study at the University and six months' practice at the works or colliery each year for a period of four years. During the first year such students should spend three terms at the University.
The LECTURE COURSES commence OCTOBER 6th, 1926.
The TECHNICAL LABORATORY COURSES commence SEPTEMBER 28th, 1926.
For further details of the Courses and for particulars of the Degrees, Associateships, Diplomas, and Certificates awarded on their successful completion, application should be made to W. M. GIBBONS, Registrar. 3023

University of Birmingham.
DEPARTMENT OF METALLURGY.
"FERRIS" PROFESSOR: D. HANSON, D.Sc.
LECTURERS AND DEMONSTRATORS: T. G. BAMFORD, M.Sc. HAROLD HARRIS, M.Sc. T. HENRY TURNER, M.Sc.
THE SESSION 1926-27 COMMENCES ON OCTOBER 4th, 1926.
The Course of Study covers three years and leads to the Degree of B.Sc. in Metallurgy. There are separate Courses for Metallurgists and Metallurgical Chemists. There is also an Honours School. Special attention is devoted to Iron and Steel, Copper, Brass, Metallography, the needs of local industries and to preparation for colonial and foreign posts.
Research and other Scholarships.
For particulars apply to the REGISTRAR. 2944

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PUBLIC NOTICES

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
DEPARTMENT OF INDUSTRIAL ADMINISTRATION.

The Governing Body invites APPLICATIONS for the following POSITIONS in the College :—
(a) HEAD of the DEPARTMENT of INDUSTRIAL ADMINISTRATION ;
(b) LECTURER in INDUSTRIAL ADMINISTRATION.
Salary in each case according to qualifications.
Conditions of appointment and forms of application, which must be returned on or before 20th September next, may be obtained on application to the REGISTRAR, College of Technology, Manchester.
B. MOUAT JONES,
Principal of the College.
3034

MANCHESTER MUNICIPAL
COLLEGE OF TECHNOLOGY.
(FACULTY OF TECHNOLOGY IN THE UNIVERSITY OF MANCHESTER.)
APPOINTMENT OF ASSISTANT LECTURER IN TEXTILE ENGINEERING.

The Governing Body invites APPLICATIONS for an ASSISTANT LECTURESHIP IN TEXTILE ENGINEERING in the College of Technology.
Salary, £250 to £300 per annum, according to qualifications. Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester. The last day for receipt of applications is Monday, 20th September 1926.
Canvassing, either directly or indirectly, will disqualify a candidate for appointment.
B. MOUAT JONES,
Principal of the College.
3043

County of London.
The London County Council invites TENDERS for the MANUFACTURE, SUPPLY, DELIVERY and ERECTION of THREE WATER-TUBE BOILERS with Auxiliaries.
The specification, form of Tender and general conditions may be obtained from the General Manager of Tramways, London County Council Tramways Offices, Victoria Embankment, W.C. 2, upon payment of a deposit of Three Pounds (£3), which will be returnable only if a bona fide Tender is submitted and not withdrawn ; but particulars of the work may be obtained at the Tramways Offices, Victoria Embankment, before payment of the deposit.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the Instructions for Tender and Form of Contract, and in the "London County Council Gazette."
Tenders must be delivered to the Clerk of the Council at the County Hall, Westminster Bridge, S.E. 1, not later than 4 p.m. on Monday, 13th September, 1926. No Tender received after that time will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
Clerk of the London County Council.
3050

Holme Cultram Urban District Council.
SEWERAGE.

The Holme Cultram Urban District Council invite complete single TENDERS from competent persons or firms for the MATERIALS to be supplied and the WORK to be executed in the LAYING, MAKING, and CONSTRUCTION of SEWERAGE WORKS in West Silloth, Greenrow, Blitterlees, and a portion of Skinburness, and a STORM WATER DRAIN in Silloth, all in the County of Cumberland, viz :—
About 2¼ Miles of 6 and 9 inches diameter Stoneware Pipes with the necessary Manholes, Flushing Tanks, Sea Outfall Tank, Underground Storage Tank to hold 16,000 gallons, Pumps, Crude Oil Engines, 6in. diameter Cast Iron Rising Main about 800 yards in length, 12in. diameter Stoneware Pipe, Storm Water Overflow Drain about 500 yards in length, and other incidental Work.
On and after the 3rd August, 1926, drawings, specification, and bill of quantities may be inspected at the office of the Engineer, Mr. J. C. Boyd, M. Inst. C.E., 18, Bank-street, Carlisle. The Engineer will supply copies of the specification and bill of quantities, &c. (one document), on the deposit of a cheque for Three Guineas, which will be returned only after the receipt of a bona fide Tender with the bill fully priced out.
The works are to be carried out under a grant from the Unemployment Grants Committee, and are to be actively begun on or before the 30th September, 1926.
Sealed Tenders, addressed to the undersigned and endorsed "Sewerage Tender," must be delivered to me not later than Noon on Monday, the 23rd August, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
J. BACKHOUSE BECKTON,
Clerk to the Council.
81, Castle-street, Carlisle,
24th July, 1926.
3011

Leatherhead Urban District Council.
SEWERAGE WORKS.

The above Council invite TENDERS for the CONSTRUCTION of TANKS, PERCOLATING and CONTACT FILTERS, CHANNELS, SEWERS, SLUDGE TANKS, PUMPS, DRYING AREA, STORM WATER TANKS, and other appurtenant WORKS, at the Outfall, Randalls-road, Leatherhead.
Specification and drawings of the proposed works may be inspected at the office of Mr. William Fairley, M. Inst. C.E., Parliament Mansions, Victoria-street, Westminster, S.W. 1, and copies of the bill of quantities and form of Tender obtained, on deposit of a crossed cheque for £3 3s., made payable to the Council, which deposit will be returned on receipt of a bona fide Tender.
Sealed Tenders, on the forms provided, are to be delivered to the undersigned not later than Noon, Monday, 6th September, 1926.
The Council do not bind themselves to accept the lowest or any Tender.
By Order,
W. J. HODGES,
Clerk to the Council.
Council Offices,
Leatherhead, Surrey,
27th July, 1926.
3023

CONTRACTS AND TENDERS.
The County of London Electric Supply Co. Ltd.
BARKING POWER STATION EXTENSIONS, 1926.
FOUNDATIONS AND BUILDINGS CONTRACT.

The County of London Electric Supply Co., Ltd., are prepared to receive TENDERS for the CONSTRUCTION of FOUNDATIONS and BUILDINGS for the EXTENSIONS at Barking Power Station.
The specification, schedule, form and Tender and other particulars can be obtained from Sir Alexander Gibb and Partners, Queen Anne's Lodge, London, S.W. 1, and drawings can be inspected at the same address on or after the 10th August, 1926.
A deposit of £15 15s. will be charged for the documents, and this will be returned on receipt of a bona fide Tender by the date below mentioned.
Sealed Tenders, marked "Tender for Foundations and Buildings, Barking Extensions," should be addressed to the undersigned, and lodged at the registered office of the Company by Noon on the 31st August, 1926.
The Company do not bind themselves to accept the lowest or any Tender.
F. C. McQUOWN, Esq.,
Joint Manager and Secretary.
The County of London Electric Supply Co., Ltd.,
Moorgate-court, Moorgate-place, London, E.C. 2.
3024

For continuation of Public Notices see page 3

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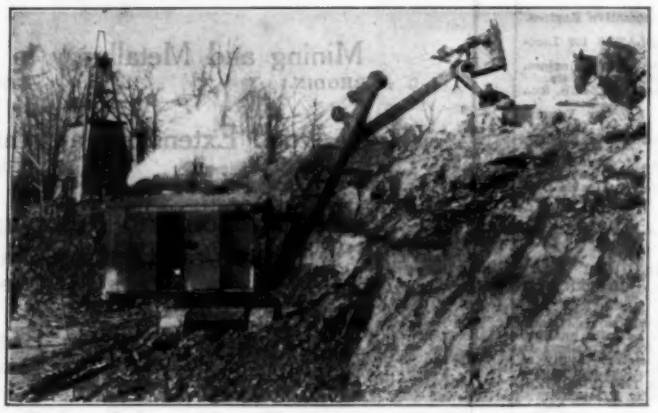

Osgood revolving steam shovels are built in various sizes and have powerful steam engines giving them the maximum of power for crowding and reach. These machines are furnished on continuous tread mountings which make it possible for the machine to move about in mud or water without difficulty. They can also be furnished with structural steel booms for clamshell, dragline or crane services as well as for shovel services.

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Standard or railroad shovels are made in various sizes with dipper capacities ranging from 1½ Yd. to 6 Cu. Yd., and these machines can be furnished upon either standard railroad trucks, traction wheels or continuous tread mountings.

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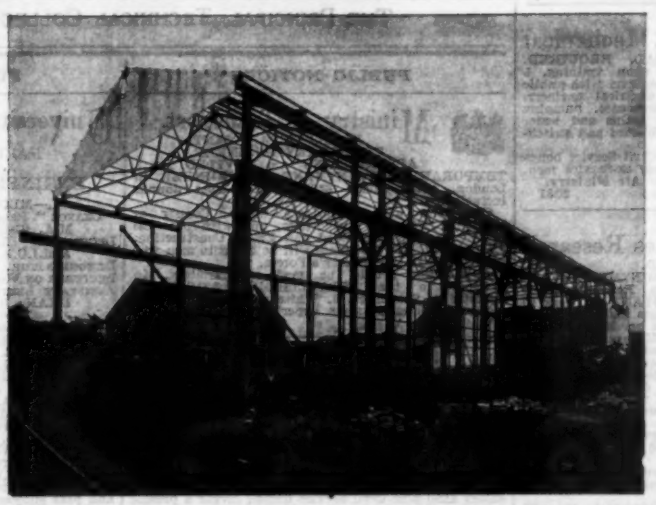
Kelvin Construction Co. Ltd.



Reinforced Concrete & Constructional Engineers.
London Office: 3, Iddesleigh House, Westminster. Phone: Victoria 582
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Works & Head Office: Kelvin Works, Maryhill, Glasgow
Telegrams: Kelvin, Glasgow. Telegrams: Kelvin, Maryhill.

A Seven-Day Journal

The Science Museum.

THE Board of Education has issued its report on the Science Museum at South Kensington for the year 1925. It records that during that year the three upper floors of the eastern portion of the new buildings were completed and occupied, adding 75,000 square feet to the 45,000 already in existence. Furthermore, 35,000ft. of the new galleries were occupied, although the work was not completed. The total space, therefore, which was used in that year was 155,000 square feet, but additional space is urgently needed, for even when full use is made of the 155,000 square feet, large numbers of valuable and interesting objects which would occupy at least 50,000 square feet more gallery space would still be in store. Steps have been already taken to provide some of this space, for in 1925 the Government authorised the construction of the four eastern galleries and the Museum front on Exhibition-road; but as that will provide only 22,000 square feet, the construction of the centre block of the new buildings, on the site of a part of the old building, which would give another 100,000 square feet, is urgently needed. The old buildings are quite out of date, and with their wooden floors and staircases, constitute a serious fire risk to the valuable collections which they contain. The most notable addition to the Museum is an accurate reproduction of James Watt's attic workshop at Heathfield, Birmingham. It contains all his machines, tools, &c., which have been placed exactly as they were at the time of his death in 1819. This room is provided with large plate-glass windows, so that visitors may inspect it without actually entering it. The visitors to the gallery in 1925 numbered 429,558, which was somewhat less than in the preceding year. The board of management considers that the incompleted appearance of the building is accountable, in some measure, for this falling off in attendance, but for some unexplained reason the holiday attendance in April and August, which generally accounts for a third of the year's total number of visitors, was lower than usual. At the end of the year, however, attendance materially improved, and was from 20 to 30 per cent. higher than ever it was before.

New Engineering and Shipbuilding Guarantees.

THE recent statement which was issued with regard to the administration of the Trade Facilities Acts shows that for the period which ended June 30th last, the Treasury has indicated its willingness to make guarantees up to a total of £64,933,280. Certain applications for shipbuilding have been withdrawn and others reduced, but in the new list applications have been granted for electrical undertakings, engineering works plant and ship construction. The sum of £1,000,000 is to be guaranteed for the building of a large modern power station at Brimsdown, Enfield, by the North Metropolitan Power Station Company, Ltd., for the North Metropolitan Power Supply Company's area. In the first instance two 20,000-kilowatt generating units with modern steam-raising plant will be installed. Another £30,000 will go to the North Somerset Electric Supply Company, Ltd., for the extension of supply facilities. Among the engineering firms to which sums are to be granted for the provision of plant and machinery are the Prothero Steel Tube Company, Ltd., £20,000, and John C. Kincaid, Ltd., of Greenock, £40,000. For the construction of ships, £50,000 is to be guaranteed to the Teakwood Steamship Company (1926), Ltd., for the building of a ship at Newcastle-on-Tyne, and £35,000 to the Rederiet Belnor Company, for the construction of a locomotive-carrying vessel, on the same river. The firm of Petaling Tin, Ltd., receives a guarantee for £80,000 for the building of two dredgers; while £70,000 is to be guaranteed to Doornkop Sugar Estates, Ltd., of Natal, for the building of a new sugar mill, the materials and machinery for which will be purchased in this country.

The Victoria Falls and Transvaal Power Company.

SPEAKING at the ordinary general meeting of the Victoria Falls and Transvaal Power Company a few days ago, the managing director, Mr. A. E. Hadley, said that during the year 1925 the maximum load developed by the turbines reached 260,000 horse-power, and of the energy sold 16·6 per cent. was in the form of compressed air and the remainder in the form of electrical units. The work at the site of the Witbank station was started in October, 1924, and within eighteen months the first machine was put into service. The station was constructed with special reference to the cheapness of the fuel in the locality, and it was of the most modern construction. The transmission pressure of the Witbank station was 132,000 volts, the highest pressure so far employed in Africa. Referring to the accident which occurred some time ago in the Vereeniging power station, Mr. Hadley said that there was no doubt in his mind, and in the minds of the company's technical men, that the cause was an inherent defect in the original forging of the turbo-generator, and was in no way attributable to the work done by the machine. On account of the lay-out of the station, the resulting damage was confined to the turbine room, and though extensive, it was much less than it might have been, as none of the steam plant or boiler-house plant was affected.

The Projected White Star Liner.

IN a Journal note of February 19th last we referred to the interest displayed in the then current reports that the White Star Line contemplated the building of a new Atlantic liner of superlative tonnage and dimensions for its Southampton–New York services. This question of the world's largest liner is again raised by the statement made by Mr. P. A. S. Franklin, the president of the International Mercantile Marine Company, on his recent return to New York, that the plans for the development of the White Star Line include the construction of five new steamships, one of which will be of 62,000 gross tons. We gather that the projected liner will be of the "Majestic" class, and as the Majestic herself has a gross tonnage of 56,500, the new vessel, if constructed, will be the largest liner afloat. On inquiry at Liverpool we were informed that the managers of the White Star Line, while stating that a front-rank steamship line, such as the White Star, is always considering new tonnage for the different services in which it is engaged, prefer to say nothing further at present. The proposal is, however, one of more than usual importance, and such a programme of development as that outlined by Mr. Franklin will not fail to arouse the keen interest of British shipbuilders.

A Successful Flying Boat Cruise.

THE safe arrival of the two supermarine "Southampton" flying boats at Plymouth on Friday last marked the successful completion of the first long-distance cruise which has been made by aircraft belonging to the Royal Air Force. The two boats were under the command of Squadron Leader G. E. Livock, and they made a round trip to Egypt and Cyprus, involving a total flight of approximately 6065 sea miles. Standard Air Force machines, with a full service load, were employed, and the flight was undertaken to a set time-table as a service exercise. Starting from Cattewater Air Station, Plymouth, on July 1st, the boats crossed to Hourtin, Bordeaux, and proceeded by way of the river Garonne to the seaplane station at Berre, near Marseilles. After a day's rest at that port, the boats then flew to Naples, where another day was spent. On July 6th they went on to Malta. From Malta the journey was continued to Benghazi on the north coast of Africa, and from that point to Aboukir, and further by way of Haifa to Famagusta in Cyprus. The return journey was made *vid* Aboukir, Athens, Corfu and Malta, after which the same course was resumed as that taken on the outward journey. The machines were equipped with Napier Lion engines, and standard wireless equipment was carried.

A New Super Power Station.

AN arrangement has been arrived at between the Home Counties Joint Electricity Authority and the Chiswick District Council for the establishment of a large generating station on Duke's Meadows, Chiswick. The works will occupy 45 acres of land, which was purchased from the Duke of Devonshire as an open space, and in place of this land the Chiswick District Council is to receive Chiswick House and grounds, consisting of 65 acres. The new works, which will probably cost at least £2,000,000, are expected to be in operation by the winter of 1928–1929, and they will serve the western area. The scheme is backed by the Government, and it is being carried out under the provisions of the new Electricity Bill. The authority concerned serves an area from Guildford in the west to Barking in the east, and from Hertford in the north to Reigate in the south, including the county and city of London.

The Silencing of Motor Vehicles.

THE warning which the Home Secretary has issued to all owners of motor cars and motor cycles, that he is instructing the police to take active steps to enforce more strictly the law relating to the use of silencers, again raises the question of the elimination of noise in motor vehicles. There are few, if any, modern motor cars which can be said to offend the ear, either with regard to their exhaust or engine noises. Unfortunately the same cannot be said with regard to the modern motor cycle, which, it will readily be admitted, —especially if driven carelessly—is a noisy machine. That there is no need of such noise is demonstrated in a paper by Mr. Harold Briggs on "The Elimination of Noise in the Motor Cycle," which was read before the Institution of Automobile Engineers in January last. The author gives some interesting test figures for different types of silencers, and shows that the additional back pressure and consequent loss of power imposed by the use of such a device is quite small. A most interesting fact emerged in the subsequent discussions of the paper, which took place at Birmingham and Wolverhampton, and the position of the manufacturers was clearly vindicated. Successful designs of silencers have been got out and standardised, but the riders demand—for, we believe, almost one-third of the machines bought—a plain open pipe. Indeed a certain section of the public would seem to prefer not a silent running machine, but one with a "good healthy bark." It is to be hoped that increased pressure by the authorities will educate public opinion in the direction of demanding the adoption of a standard silencing system similar, perhaps, to that which has been introduced with success by the Brooklands Automobile Racing Club.

Professor Dempster Smith.

THE Manchester City Council and the Council of the University of Manchester have approved the appointment of Mr. Dempster Smith, M.I. Mech. E., to the Chair of Mechanical Engineering in the University and in the College of Technology, in succession to Professor G. Gerald Stoney, F.R.S., who has resigned that Chair in order to take up an important industrial appointment with C. A. Parsons and Co., Ltd. Professor Dempster Smith, who has been a member of the staff of the Mechanical Engineering Department of the College for upwards of twenty years, has also gained wide experience in works practice and management. He has maintained a close connection with industry during the period of his lectureship in the College and, in addition to his lectureship in mechanical engineering, Professor Smith has, during the past five years, had direction of the College Department of Industrial Administration. For many years he acted as experimenter and reporter to the Lathe Tool Research Committee of the Manchester Association of Engineers, and his researches in this subject are well known to our readers. Professor Smith is also a member of the Cutting Tool Research Committee of the Institution of Mechanical Engineers and other committees of several engineering institutions.

The Kelvin Hall of Industries.

THE new Kelvin Hall of Industries, which is being built at Kelvinside, Glasgow, to replace the exhibition hall which was destroyed by fire last year, has now reached an interesting stage in its construction. It is a substantial structure of stone, brick, and ferro-concrete, and is in marked contrast to the temporary character of the earlier building. The new building is being built to the design of Mr. Thomas Somers, M. Inst. C.E., the City Engineer of Glasgow, and it has a clear floor space of about 20,000 square yards, which will be available for exhibition purposes. In other parts of the exhibition building, a suite of offices with waiting rooms, conference rooms, and an exhibitors' club, are to be provided. The principal feature of the exhibition hall is the series of large-span curved roofs which are supported at the walls by square columns and inside the hall by continuous beams carried on octagonal columns spaced at about 55ft. centres. There are three clear spans of 110ft. and one of 60ft. The trusses are 18ft. apart and consist of a tie beam with hangers and a curved rib with curved ferro-concrete slabs 4in. in thickness. At the present time some of the bigger spans are in course of completion and a very large quantity of wood scaffolding is in use. This part of the work is being carried out to the designs of Considère Constructions, Ltd., of London, and the main contractors are John Train and Co., Ltd., of Glasgow. The front elevation of the new hall will be faced with red sandstone, so that it will harmonise with the adjoining Art Galleries. It is hoped that the new hall will be completed either in the late autumn or early next year.

New Canadian Pacific Vessels.

THE orders for the new shipbuilding programme of the Canadian Pacific Railway Company, which includes the building of two passenger liners and five cargo ships, have now been completed by the placing of the contracts for the last two cargo vessels with the firms of Barclay, Curle and Co., Ltd., Glasgow, and Sir W. G. Armstrong, Whitworth and Co., Ltd., of Newcastle-on-Tyne. It will be recalled that the same two firms, together with William Denny and Brothers, Ltd., of Dumbarton, were each successful in obtaining one of the three cargo ships, the orders for which were placed at the end of June last. The new vessels are, we understand, to be delivered in about one year's time. They are ships of about 10,500 tons deadweight carrying capacity and will have from 75,000 to 80,000 cubic feet of refrigerating accommodation. The length over perpendiculars is 495ft., the breadth 61ft., and the depth 40ft. 6in. At first it was thought that the last two ships to be placed would be motor-propelled vessels, but we learn that, like the first three, they will be geared turbine ships. The coal burning boiler installation will be designed for a working pressure of 250 lb. per square inch, and a combined arrangement of Yarrow and Scotch boilers with mechanical stokers will be employed. It is of interest to note that five of the seven orders placed have been secured by Clyde firms, two going to the Tyne. The two passenger liners, as announced in our Journal note of June 25th, are to be built at Clydebank and Dalmuir by John Brown and Co., Ltd., and William Beardmore and Co., Ltd., respectively, and are to be ready for service in 1928.

New Filtration Plant at Walton-on-Thames.

NO. II.*

THE discharge of filtered water from the primary filters is into a clear water channel that leads into an open well formed in the centre of the length of the building. From this well, which is lined with white glazed tiles, the water passes through a large circular bell-mouthed orifice into a 60in. cast iron main which takes it between the two rows of secondary filter beds. It has already been explained that there are six of these beds. They are arranged in two sets of three filters on either side of a central passage-way.

The secondary filters are of the Board's standard type and do not call for any special mention. The following brief description of them may, however, be given. Each, as has been said, has an area of five-sixths of an acre. The floors and walls are of mass concrete. The floors are in two layers, between which is laid a waterproofing layer of asphalt ¾in. thick. This layer is carried into the wall foundation, where it is joined to bituminous sheeting extending the waterproofing layer into the puddle backing of the walls, which has a thickness of 2ft. The walls are faced internally with Staffordshire brindle bricks, the tops being finished with bull-nosed blue brick coping. The floors are covered with Fletton bricks to form the under drain. These bricks are laid in two layers, the lower layer being laid transversely at a distance apart equal to the breadth of a brick, while the upper layer is arranged longitudinally with close-butting joints. Grooves are moulded in the sides of the bricks to allow of a freer passage of the water than there would be with close joints. On the top of the upper layer of bricks there is a 9in. layer of shingle, all of which has passed through a screen having square ¾in. meshes, and all of which was retained on a screen having meshes ¼in. square in the clear. Above the shingle there is a layer of sand 2ft. 2in. thick, which is expected to reduce to 2ft. when the filters are brought into operation. A great deal of care was taken in specifying and selecting the sand. The limiting percentages to be retained on sieves of various meshes were specified and curves showing the limits of coarseness and fineness were prepared. This is, we believe, the first occasion on which the Board has specified the dimensions of the grains going to make up the filter bed sand, and it certainly puts the matter on a sound scientific basis, which should render the comparison of the operation of different filters much more reliable than it has hitherto been.

A drawing showing the arrangement of the piping at the inlet bays of the secondary filters is given in Fig. 12. Each filter is fed by a 27in. diameter branch from the 60in diameter main leading from the primary filter house, the branch delivering into an inlet chamber. The front wall of the inlet chamber is carried up above sand level to baffle the flow, and the side walls are used for the overflow sills. In each side wall there is a recess 3ft. wide and 9in. deep, and there are grooves at the sides of each opening for the insertion of cast iron bars 1in. square, which can be removed one by one as the level of the sand in the filter is lowered after cleansing. After cleaning, the filters will be charged with filtered water from adjacent beds to a level slightly above the top of the sand by back flow through the under drain. There are two vent pipes, one on either side of the inlet chamber, for the escape of air when filling the filters. The main drainage channel runs along the centre of each filter from the inlet side to an outlet chamber, which is furnished with four baffle walls so as to ensure a thorough mixing of the water and chlorine—when the latter is used—for it is at the inlet of the outlet chamber that it is applied. The water from each filter is measured on leaving the outlet chamber by means of a Venturi meter in a 21in. outlet pipe. The apparatus for recording the measurements for each set of three filters is contained in a brick house alongside the central of each set of three filters, and the chlorinating apparatus for the three filters is contained in the

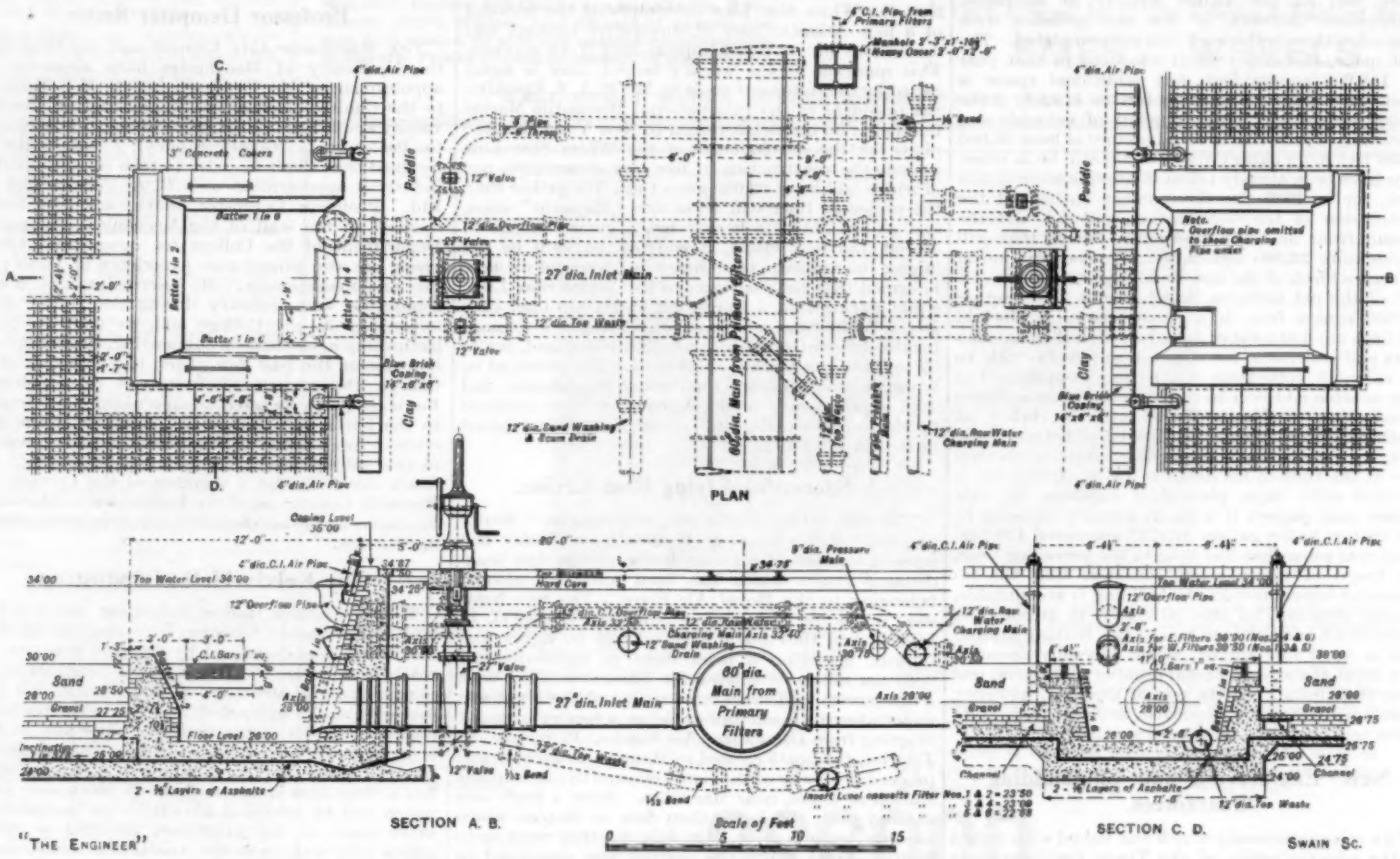


FIG. 12—ARRANGEMENT OF PIPING AT INLET BAYS OF SECONDARY FILTERS

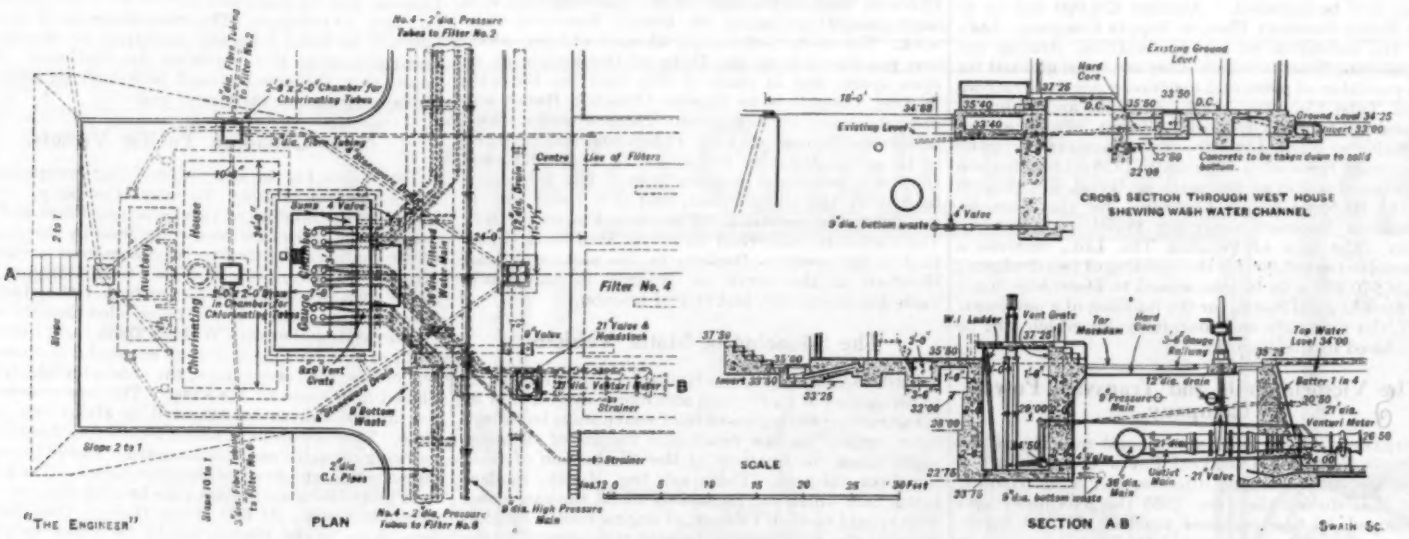


FIG. 13—ARRANGEMENT OF OUTFLOW METERING AND CHLORINATION HOUSE

* No. I. appeared July 30th.

same house. There are pipes by means of which raw river water can be applied to the top of the beds when it is desired to form a filtration film quicker than it would be formed by the use of pre-filtered water.

The chlorine is used as gas and is administered by four Paterson Chloronomes, comprising two duplicate installations, one in each of the outflow metering houses. The Chloronome receives the chlorine gas from cylinders, reduces its pressure and measures the rate of flow, afterwards converting it into an aqueous solution which is mixed with the water at the outlets

from the secondary filters. Each of the chlorinating units is stated to be capable of effectively sterilising 40,000,000 gallons of water daily.

A cast iron pipe, 12in. in diameter, leads from a sump in the inlet chamber of each filter, through the filter wall, and is connected with a 12in. diameter top-waste drain laid under the central road, which discharges into a 12in. drain coming from the sedimentation tanks to which reference will be made later. Each outlet chamber has a 9in. diameter cast iron bottom-waste pipe connecting with 9in. diameter bottom-waste drains under the eastern and western roads respectively. The bottom-waste drain on the western side is carried forward under the northern road to connect with the bottom-waste drain on the eastern side, the joined drains being continued into the intake channel.

Scum overflows are provided at the four corners of each filter. They deliver into 12in cast iron drains laid under the eastern, western and central roads, and connected with a joined drain under the northern road, which is 12in. in diameter between the eastern and central trenches, and then increases to 15in. diameter. This drain, which discharges into the northernmost sedimentation tank, also takes up the discharge from the sand washers from the secondary beds to which we refer below.

For washing the sand of the secondary filters two hydraulically-operated ejector hoppers are arranged in each bed. The discoloured layer at the top of the bed is skimmed off and the material removed is taken in wheelbarrows to the two hoppers.

The water for ejecting and conveying dirty sand to the washers—which run on rails lad between the rows of filters, and are hence movable from filter to filter—is supplied through a 3in. galvanised wrought iron pressure pipe, connected to a high-pressure cast iron main laid round the filters, and referred to below. At the hopper this pipe is reduced to 1½in. in diameter, and is fitted with a nozzle which terminates a short distance from the bell mouth entrance to the outlet pipe. A 1in. diameter perforated branch, controlled by a stop valve, leads from the 3in. supply pipe over the top of the hopper to stir up the sand in case of stoppage. When the ejectors are in operation, 3in. diameter wrought iron pipes are temporarily employed to connect the outlets from the ejectors to the sand washers, of which there are three sets, each consisting of four hoppers.

The clear water for the sand-washing operations for both the primary and secondary filters is supplied through a 12in. main—reducing to 9in. and 6in.—taken from the delivery main from the new pumps. Ultimately the pressure head in this pipe will reach 250ft., and when that head is reached it will be sufficient for the operation of the sand ejectors at the secondary beds. For some time after the main delivery pipe is brought into service, however, it may be worked at a pressure considerably below that figure, and, consequently, it has been necessary to install two electrically driven booster pumps to raise the pressure for the secondary bed sand washing from pressure heads varying between 100ft. and 250ft. The pumps, which are in the primary filter house—see Fig. 11 *ante*—were made by W. H. Allen, Sons and Co., Ltd. The electric current required to drive them, as well as that for operating the air compressors already mentioned, is obtained through underground cables from a 150-kilowatt steam-driven generator—also of Messrs. Allen's manufacture—which is in the main engine house. The supply of water to the wash-water tank in the roof of the primary filter house, which will be used solely for cleansing those filters, and the supply of water to the sand ejectors and washers at the secondary filter beds, will both be metered.

For dealing with the wash-water from the sand washers of the secondary filter beds and from the primary filters there are four sedimentation tanks—see Fig. 14—three of which are for the primary filters and one for the secondary filters. Their positions will be seen in the general plan Fig. 1 *ante*. Like the filters, these tanks are in mass concrete, the external walls being finished with bull-nosed blue brick coping and the division walls with pre-cast concrete coping. After being given time for the solids to settle, the clear super-natant liquid is drawn off by means of floating-arm drainers, which deliver into 9in. outlet pipes connected with a 12in. collecting drain. The water in this drain can either be discharged (*a*) into the intake channel, thence to be pumped back into the reservoir; or (*b*), should the water be for some reason unfit for that purpose—say, because it is heavily charged with algæ—into a 15in. stoneware drain, which will deliver it into river below the Board's intake.

The outlets from the sedimentation tanks are controlled by 9in. screw-down sluice valves. The inlet to the fourth sedimentation tanks from the wash-water drain from the secondary filters is controlled by a disc valve, while the wash-water from the primary filters enters each of the sedimentation tanks through four openings in the wall which separates the wash-water channel from the tanks. These openings are controlled by hand penstocks. The floors of all the tanks are laid with a fall and at the lower end of each

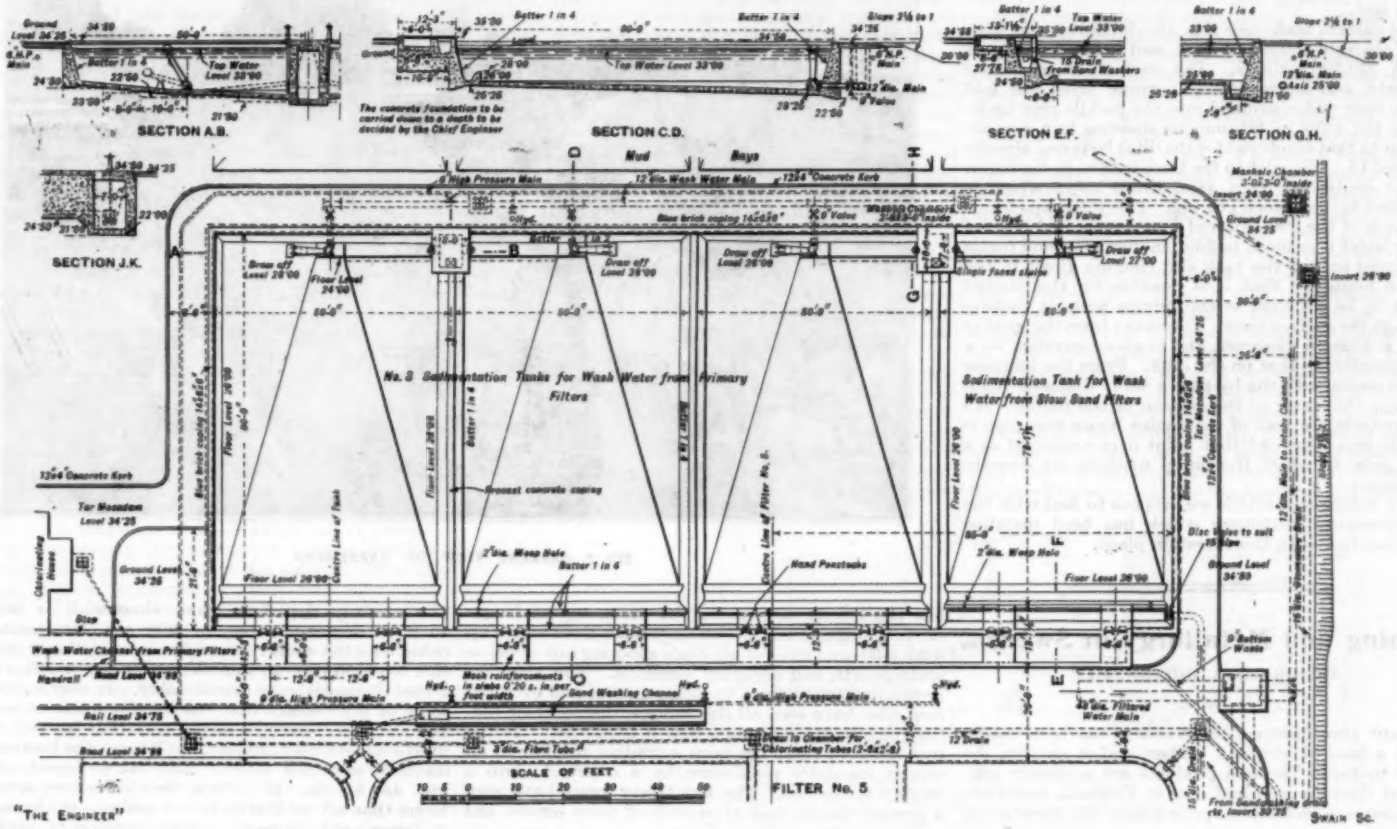


FIG. 14—SEDIMENTATION TANKS FOR WASH-WATER FROM PRIMARY AND SECONDARY FILTERS

tank, and a channel conveys the sludge to covered chambers, of which there are two, each serving two tanks. The sludge is pumped from these chambers to mud bays, formed alongside the tanks by small centrifugal pumps arranged at ground level. These pumps are driven by Pelton wheels which are actuated by water from the high-pressure sand washing water main. The pumps and Pelton wheels were supplied by the Pulsometer Engineering Company, Ltd.

The mud bays, of which there are four, are formed with earth banks covered with turf, their floors being covered with about 9in. of large gravel tailings from the concrete aggregate. It is anticipated that by this arrangement the water in the sludge will drain away and percolate into the ground. In each bay two concrete wheel tracks have been laid to facilitate access for carts removing the sludge. At the moment it has not been decided, we believe, exactly what will be done with the dried sludge. It is quite possible that it may be found useful as a fertiliser or a ground lightener, and in that case it may find a ready sale among local farmers and gardeners. If no sale is found for it, it will be spread on adjacent land belonging to the Board.

The filtered water discharged from the secondary filters is, as has already been explained, measured on leaving the outlet chambers by Venturi meters, arranged in the 21in. outlet pipes, being previously chlorinated, should that treatment be deemed necessary. The arrangements at one of the meter and chlorinating gear houses are shown in Fig. 13. Filtered

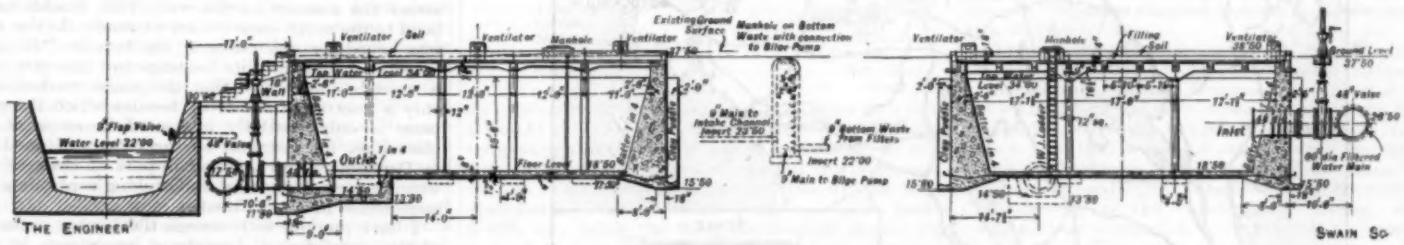


FIG. 15—COVERED FILTERED-WATER SUCTION TANK

water mains, varying from 36in. to 48in. in diameter, are laid under the roads on the eastern and western sides of the filters. The filtered water main on the western side is connected at the junction of the western and northern roads by means of a large manhole to a 54in. diameter main laid under the road under the north side of the filters. At another large manhole, junction is also made between this main and the filtered water main on the eastern side of the filter beds. From this manhole a main, 60in. in diameter, is taken to an underground suction tank from which it is drawn by the pumps in the main engine house to be passed on to the delivery mains. All the inlet and outlet mains to and from the filters are of cast iron. Those of 60in. diameter were cast with two ribs to ensure that the pipes should retain their circular shape when they were being conveyed to the site and being laid.

The suction tank—see Fig. 15—is constructed with mass concrete walls and floor, and has a capacity of about 250,000 gallons. The roof is of reinforced concrete, and an asphalt waterproof layer was laid in the floor and continued into the puddle clay backing to the walls in bituminous sheeting in a manner similar to that employed for the filter beds and already referred to. The inlet to the tank is 48in. in diameter, and is controlled by a 48in. sluice valve which is actuated by headstock gearing. This inlet pipe forms a branch of the 60in. filtered water main, and beyond it the latter is reduced to 36in. in diameter, and forms a by-pass around the tank and running direct to the engine house, so that it is possible for the filtered water to be supplied to the pumps without passing through the suction tank. The outlet from the suction tank is 48in. in diameter, and is also controlled by a valve similar to that on the inlet. From the junction of the outlet with the by-pass a 60in. diameter main conveys the water to the suction of the pumps. To just outside the wall of the engine house this pipe is of cast iron; beyond that point it is continued as a steel pipe, to which the pump suctions are directly connected.

In a subsequent article we propose to deal with the new pumping machinery which has been installed in connection with this filtration plant.

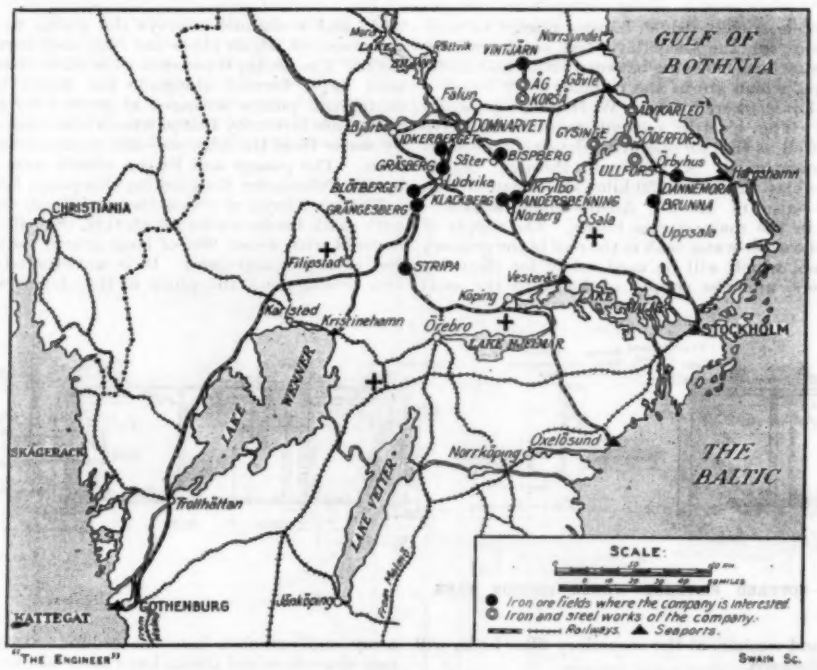
Mining and Metallurgy in Sweden.

By JOHN G. A. RHODIN, F.I.C.

No. I.

FROM time immemorial Sweden has been essentially a land of iron and timber, and it remains the same to-day. The two products are as closely connected there as iron and coal in England, and from that reason a pleasant surprise awaits the members of the Iron and Steel Institute during their visit to Stockholm early this autumn. Almost all iron mines and smelting works are situated in places of exceptional natural beauty, and traces of the industrial activity are confined to the nearest few hundred yards round the furnaces, which are generally enclosed in more or less picturesque buildings. Everything is comparatively clean, as pig iron smelting is done with charcoal, with very few exceptions. No "black country" is to be seen anywhere, nor anything approaching to it, from the contributing cause that the works are many and far apart, the actual determination of locality depending upon the occurrence of water power. Right back in the Middle Ages hammers and furnace bellows were driven by primitive impact wheels; to-day, the same streams and rivers drive power stations of the most ultra-modern kind, which supply power and light to vast districts. The changes have been so gradual and continuous that it is almost impossible to point to epochs in the history of the Swedish mining and smelting industry. It has changed

FIG. 2—GENERAL VIEW OF DANNEMORA



"THE ENGINEER" SWAIN Sc.

FIG. 1—MAP SHOWING MAIN PORTION OF "CENTRAL" SWEDISH MINING BELT

nobody has been surprised. Only the miners and iron workers carry on their original traditions, and imported types, like the Walloons, called in during the twenties of the seventeenth century, remain distinct from the natives of the country. Unfortunately, industrialism is beginning to affect the larger undertakings, and "mountain men" and "hammer smiths" are probably doomed as a distinct tribe.

The minerals found is Sweden are very numerous, but only iron ores occur in such quantities as to be of international importance, though in olden times there was an overseas trade in copper and silver. Before proceeding with these matters, it will, however, be necessary to make an excursion into the topography of the country.

The mean time in Sweden is just English Summer Time or Central European Time. By some fortunate chance, this coincides with the meridian of Orebro in the Central Swedish mining district, which is to all intents and purposes the central one in the country. The easterly departure from Greenwich is hence 15 × 60 degree-minutes, or 900 cos. lat. nautical miles. As the country stretches in a northerly direction from 55 deg. 20 min. N. to 69 deg. 4 min., the actual distances vary considerably. It may astonish some of my readers that the longest distance north and south in Sweden is as much as that between the most southern town, Malmo, and Rome. The maximum distance east and west is also fairly considerable, viz., 450 kiloms. In surface, Sweden is considerably larger than all the British Isles together. Geologically it forms with Norway a huge outcrop of archaic rock, very much denuded by glacial action, but luckily some stratified rock remains. Still, the archaic rock shows up everywhere and the gneiss is to every child in the country simply "grey-stone." Eruptive rock like granite and pegmatite is also very common. As a matter of fact, granite forms whole mountains in some parts, providing an inexhaustible supply of excellent building stone, as well as highly decorative varieties. The pegmatite dykes yield the bulk of potash felspar used in Europe, and, besides that, an incredible variety of rare minerals. Near Stockholm one of them, Utö, has supplied specimens to practically every collection of minerals in the world. It is a matter of history that a great many rare earths were discovered in Utö minerals, which thus enter as essentials in the history of chemistry; but that is another story. The map shows the main part of the "central" Swedish mining belt, which stretches across the country to the west from Stockholm to bend to the north some distance inland. As this map was issued by one concern, the famous "Kopparberget," to illustrate its holdings and interests only, it must be understood that the places marked form only a fraction of the total, besides which the company is only partially interested in some of the places, as, for instance, to the extent of one-third in Dannemora and one-half in part of Grangesberg, which is a great national undertaking controlling the large mines in Arctic Sweden.

I have marked with crosses the further extension of the metalliferous deposits of importance in connection with iron and steel, but there are others of various kinds all over the map. At the northern end of Lake Vettern, for instance, there is the famous Ommeberg lead and zinc mine, and at the southern end Taberg, a mountain of titaniferous iron ore, sometimes carrying vanadium, which was isolated and added to the elements from that ore by Saefström. Not far from Ommeberg, at the place marked with a cross, Arfwedsson isolated lithium, selenium was discovered in flue dust from Falun, &c. &c. One might say that the whole history of Sweden, political, economic, literary and scientific, was played out on the ground covered by this map.

Apart from plains on each side of the Vettern and round the ancient city of Upsala, the whole country is covered with forest. "Whitaker's Almanack" describes Sweden, probably from impressions gleaned during a journey between Gothenburg and Stockholm, as "mostly flat with pleasant undulations." Every-

like the forests surrounding it, which are no longer of their original form, with huge mast trees mixed up with self-sown trees of all kinds shooting out of dense undergrowth and decaying windfalls. Now they are grown for timber for a specific purpose, and even old men who have seen all the changes during their lifetime cannot say when and how it happened. In the iron industry there has been a gradual swelling of an almost inaudible pianissimo by a crescendo into a mighty fortissimo. The last thirty years have seen a greater change than thousands of years before, and

thing depends upon the meaning of the word undulation; on our map the north-western Swedish part has an average height above sea-level of 1000ft., rising in places to 3000ft. The mines on the whole lie low, 300ft. and less, but the southern part on our map averages 600ft., with Taberg up to 1000ft. The surface of Lake Vettern is 270ft. above sea-level. Having climbed a good few of them, I can assure the reader that these undulations are rather sudden and far from pleasant in hot weather. As the railways are built to avoid tunnels and deep cuttings, no idea can be formed of the formation of the country, which offers a greater variety of scenery and climate than any other European country, during a railway journey in these parts—only forest and water in the form of rivers and lakes attract the eyes almost incessantly. In the utmost south the beech forest predominates, and the walnut tree thrives, in the extreme north in the mountains the dwarf birch (*Betula Nana*) rises fewer inches than its relatives in Central Sweden rise feet.

Leaving this departure from the subject and returning to the iron ores, these are mainly magnetic ore, mixed with hematite, either practically free from phosphorus or rich in that unpleasant impurity, the former being the raw material of what is known as Swedish iron and steel. The deposits occur in ore-fields amongst stratified rock of high age, and the eruptive dykes in the gneiss only very seldom carry iron ore. In Sweden mica-schist, chlorite, hornblend, &c., are characteristic rocks with the rest of the pre-cambrian formations. The silurian formation, even, is rare, and occurs—from memory—only at Ommeberg and Kinnekulle—south of Lake Wenern—on our map. A fair amount of silurian limestone is quarried, containing fossils like orthoceratites and trilobites, &c., but it is not, to my recollection, used for smelting, as it contains phosphorus. Pyrites occur almost everywhere in Sweden and chalco-pyrites in some places. The former is mined to the extent of 70,000 tons a year at Falun in the world-famous old copper mine, Kopparberget. Copper ores are mined and smelted in a few places, and there is a great revival of interest in that class of undertaking just at present.

On the whole, the geology of Central Sweden is utterly complicated, that of the strip to the west of Lake Wenern, Dalsland, in particular. The various forces of Nature seem to have had a battle-royal in that quarter right up to historical times almost. From fear of geologists *ex professo*, who are very exclusive, I shall only mention that the coast has risen over 150ft. since men went down into the sea in ships, remains of a landing-stage, a sea-anchor, &c., having been found amongst shells of now living marine molluscs at Trollhättan—and in Galileo's words, "she keeps on moving." When the ice during the glacial period "polished off" this side of the Scandinavian peninsula, it was impolite enough to take the true coal formation with it—maybe to the bottom of the Baltic, or maybe to Germany. Nothing now remains, and the modicum of coal found in the south belongs to older formations. The national importance of the Swedish coal seams lies in the fire-clay found with them, a discovery made altogether too late in the day, as that class of clay had to be imported before. To avoid monotony I shall have to leave the enormous iron ore deposits in Arctic Sweden for treatment with the modern developments, to make a short historical survey.

When Swedish history proper began, iron smelting in the country was quite old, probably more than a thousand years of age. The idea of the Stone Age, Bronze Age, and Iron Age must be taken with a considerable quantity of salt. Similarly, the convenient theory of periodical immigrations of various races, as it is proved that the Nordic race has existed in that country contemporary with the very oldest of old relics found. What is more, this race must have had a civilisation of no mean order, as the objects found differ from those found in other countries mainly by their more pleasing and often artistic form and excellent workmanship. This applies in particular to prehistoric bronze implements, some of which are extremely beautiful, as a visit to the National Museum in Stockholm will prove to anybody. That the style of decorations is reminiscent of the tattoo-marks which adorned a New Zealand warrior, does not prove that the makers were cannibals any more than that these objects are actually precursors of iron implements found. One thing is a certainty, this class of implement could not have been responsible for the mysterious rock carvings found in various parts of Sweden and ascribed to the "Bronze Age." Wooden sticks and sharp sand might have done it, if the artist had lived long enough, which is doubtful, as the archaic rock is a most stubborn passive resister. Besides this, the pictures show ships of apparently largish size, chariots, fights with weapons, &c., all pointing to a somewhat unexpected state of development. This may have been made possible by the use of iron or it may not, but the balance of probability is that it was. Whether the use of iron started 600 B.C. or 6000 B.C. is of small importance to us now; who invented it will never be known any more than how it was done.

Coming to known facts, Norsemen appeared in numbers fairly suddenly on the English coast and elsewhere during the fourth century A.D., and they came in seaworthy ships, with undoubtedly serviceable iron or steel weapons, and they carried almost everything before them practically everywhere. To the Romans they were barbarians, but what made these excursions possible for many centuries afterwards year after year? Weapons must have been made and ships built on quite a considerable scale, which means that industry of some kind or another must have supplied the wants. The ships, or, if you like, overgrown rowing boats with a single sail were the most marvellous of all. To cite an example, some of these boats were unearthed in 1863 from a bog in Denmark, together with Roman coins dated 217 A.D. One of them was built from oak planks, 80ft. between the perpendiculars, 11ft. beam, clinch built from eleven huge planks. The keel plank was in one, 48ft. long! It had rowlocks for twenty-eight oars, and in design it was almost like a Norwegian whale boat of to-day. These boats or ships must have been made in very great numbers, and it would require more than one historian or antiquarian to persuade the writer that the necessary planks were made without serviceable tools of something like tempered steel. The art of building such boats otherwise survives to this day, and the fishermen on the Swedish west coast and on the Norwegian coast near Oslo are past-masters of the craft. That they still clinch the boarding with wooden plugs and wedges shows two things, the antiquity of the art and a traditional knowledge of the pernicious influence of sea water on metals. This after 1600 years—was it then likely that the development was much quicker before 200 A.D.? There is, of course, absolutely no doubt that iron of certain hardness was used and made in the then numerous small Scandinavian countries or kingdoms, but was the raw material bog ore as elsewhere, or had mining begun?

So far it is agreed that rock mining in Sweden existed in the twelfth century, but plenty of iron specimens belonging to periods B.C. exist. One would think that analyses of these specimens would show high percentages of phosphorus for bog-ore iron and low percentages for iron from ore from the rock. This is now called the vulgar way of looking upon the problem. How the more learned people look upon it is difficult to decide, but the last issue of *Jernkontorets Annaler* contains an article by Arthur Nordén, who leans towards that learned opinion and has analyses of museum specimens to prove his statements. He gives analyses of some thirty-seven specimens from various periods and various parts of the country. Analysis No. 1 refers to a sickle from the time of Christ approximately. It showed:—

	Per cent.
Total carbon	0·73
Silicon	0·07
Manganese	Traces
Phosphorus	0·028
Sulphur	Not determined (?)

As sulphur in all these specimens is very low as a rule, I should conclude that the specimen is a high-class tempering steel, which it would be difficult to beat outside Sweden. Quite a number of the specimens, ten out of thirty-seven, show less than 0·1 per cent. phosphorus, four are below 0·03, and three below 0·025, *i.e.*, below the limit for Swedish export pig iron of to-day. Nordén refuses to draw any conclusion, as the average phosphorus contents of Swedish lake and bog-ores are just (*sic.*) 0·05 per cent. Admitting this, one would think that iron made from such ores should contain more than 0·1 per cent. Anyway, a pig iron, still made from lake ore, which contains 0·53 per cent. P, does itself contain 1·2 per cent. P according to official Swedish analyses, and I got just about the same result when analysing this particular iron during the war for a firm in London. The lakes in that specified part of Sweden are the exception according to the author in question. That a reduction of the phosphorus contents could have taken place during the ancient process of making iron sponge and hammering it as Mr. Nordén suggests is not proved, if based upon a solitary slag analysis, which he did, unless the materials are known as to composition and quantity relative to the ore. This departure was caused by an axe from about 1000 A.D. containing as little as 0·005 per cent. P. However inconclusive these analyses may seem, they point towards smelting with mined ores with far greater probability than the other way. Three arrow heads were amongst the specimens analysed and had the remarkable composition:—

	Per cent.
Carbon	0·40
Silicon	1·55
Phosphorus	0·32
Manganese	Traces

The period is given as 650–700 A.D. This iron would be somewhat peculiar to "break down" under the hammer, as it should be short both hot and cold. Were they perchance cast? An etched polished section of that steel or iron should be of great interest. The high carbon contents should make it very hard in conjunction with the silicon and phosphorus, and hence serviceable for the purpose intended.

It would be outside the subject to discuss all the analyses of prehistoric iron which are given in the article referred to. Some are undoubtedly those of tempering steel and others of soft, the percentages of manganese are quite small, and the sulphur contents incredibly so. Furnaces have been found, dating from these early times, and Fig. 3 represents a section of one of the earliest type. It is a wind furnace with the air shaft side by side with the furnace proper. In working, wood was first charred without proper air supply over the charges and afterwards smelting proceeded with free access of air. Only a pasty condition of the reduced iron could be arrived at, and the refining was done by repeated heating and hammering. Any detailed description of this performance, as so often given in text-books, must be more or less imaginary, or, as in the case of Swedenborg's narrative in "De Ferro," refer to later times. When bellows were first used is a matter of conjecture, like the first appearance of the Osmund furnace. These furnaces, which are miniature blast-furnaces, were, according to Beck, the German authority, first used by Scandinavians and Finns, and the same writer states that they were introduced into Germany from Sweden. The word Osmund was written Assmund and Assmuntz in old Swedish, and may have been derived from A = stream, and "mund" = mouth, referring to the places where lake ore was mined. It is also said to mean bog or lake ore. These derivations are, however, so easily made and so difficult to prove that they must not be taken as by any means binding. The Osmund furnace continued in use in some parts of the country right into the nineteenth century under the name of wolf or blow-furnaces. As they were built above ground the slag was tapped as in a blast-furnace. Separate charcoal burning no doubt started at a very early date.

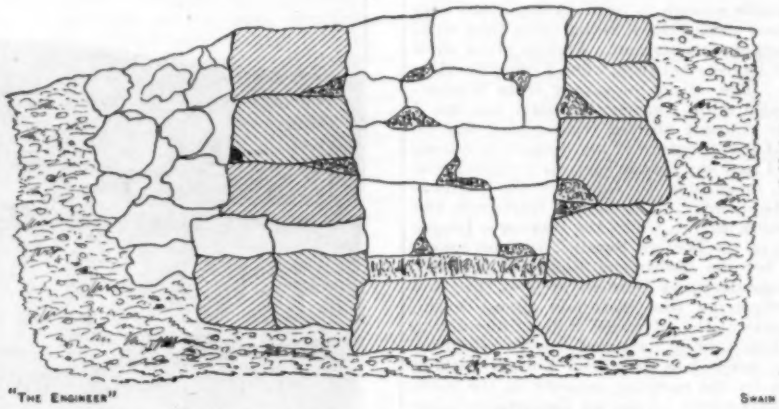


FIG. 3—SECTION OF EARLY SWEDISH SMELTING FURNACE

Christianity was introduced into Sweden during the period 800–1060 A.D., and at the end of that period mining history begins. Documentary evidence does not exist older than 1288, when a share in the Stora Kopparberget (Great Copper Mountain) was transferred. In 1303 came the still existing transfer of shares in Norberg's "iron and steel mountain" to the infant King Birger. The connection between the Christianising of the country and mining, which many authors emphasise, is not so absolutely certain. Systematic mining with a set plan may have been started under foreign influence, but the system adopted in the oldest Swedish mines—if it can be called systematic, after all—is so primitive that one must be excused for doubting the absolute truth of these statements. To get an idea of the style of mining used in these times it is best to take the above-mentioned copper mine, "Stora Kopparbergot," after which a mining district or "Bergslag" is called. This word is derived from the genitive of "Berg," *i.e.*, Bergs—in English, mountain—and "lag," which may mean "lay," as used in "lay of the land," or else the prosaic expression "gang," if referring to the men who worked it. The exact meaning does not matter very much, but all Central Swedish mines belong to one "Bergslag" or another, with separate legislation, privileges, and the like. "Stora Kopparbergs Bergslag" was formed or defined somewhere about 1225 A.D. It was a kind of company or partnership of miners working the copper mine with definite shares or holdings. By Royal privilege the liability

of the shareholders was limited to their shares or determined by them. The oldest letter of privileges still in existence dates from February 17th, 1347 A.D. It confers upon the company, amongst other things, criminal jurisdiction in its own district. Whether it was a limited liability concern in the modern sense or not, the fact remains that the present company is the same old trading combination, and thus the oldest of its kind in the world. The mine itself is situated at the old town of Falun—shown on map—and was originally composed of three vertical pits with connecting workings, which were as wide as 90ft. in places, one on the top of the other down to a depth of 500ft. As the supports were too weak, the roofs fell in periodically till the modern aspect of the main pit—shown in Fig. 4—resulted. The art of mining was in those days neglected to a great extent, and more attention was paid to the process of smelting, the miners being partners in the smelting works as well as in the mines, a strong argument in favour of the Swedish early development being independent of the contemporary German enterprises, as mining and smelting were distinct undertakings in Germany. There was, of course, a lively intercourse between Sweden and that country through the Hanseatic ships, which, beyond all doubt, carried both Swedish iron and copper for distribution elsewhere. As a matter of fact, lumps of metal, iron and copper, were used as a primitive coinage, as was the case in South Wales during Cæsar's invasion.

As I have pointed out before, specimens of excellent Swedish iron and steel from that early period are still in existence, but historical notes are lacking till we find export existing, when "Kopparberget's" actual history began some 1000 odd years later. The output of iron in Sweden has been estimated at—

	Tons per annum.
A.D. 1301–1400	3400
A.D. 1401–1520	5100

As these figures are based upon documents in the possession of the Swedish "Mountain College" and "College of Commerce," and form a conservative official estimate, the output of iron must have been considerable enough to form an important item in international transactions, being more than sufficient for internal consumption. Figures given show a similar slow increase till 1636, when a rapid development began. The output of copper from Kopparberget was also quite considerable early on, but I must for the moment abstain from giving figures, as the bulk of the literature at my disposal is mining history; but I may say that in very early times it was of sufficient magnitude to influence the political history of the country. During the thirteenth and fourteenth centuries, *i.e.*, whilst the Hanseatic League had a footing on the Thames, Swedish iron and copper must have become known in England, probably mainly as manufactured German articles, England itself still exporting raw materials almost exclusively. In spite of the advanced state of metallurgy in Sweden then, mining remained utterly primitive. The old iron mines had also been worked without consideration for the carrying capacity of the roofs, and the modern aspect of the old Dannemora mines—Fig. 2—was caused by a similar collapse as that at Kopparberget. This mine, which will probably be shown to the members of the Iron and Steel Institute, produces the best ore for steel manufacture known anywhere. As mined it contains the necessary slag-forming minerals in correct proportions; it also carries a suitable amount of manganese, the percentage of phosphorus is incredibly low, 0·003 per cent. and less, and that of sulphur insignificant. It is hence not to be wondered at that the ancient Kopparberg Company in late years has acquired a part of Dannemora.

With regard to other metals like silver, which has also been smelted in Sweden since ancient times, there is less interest in that class of industry to engineers, and I shall hence proceed to make a very brief summary of what has been said up to now. We have seen that iron smelting at least has been continuous from pre-historic times. When actual mining in the rock started is a matter of controversy; but the writer is convinced, with a number of others, that earlier dates ought to be ascribed to it than those based on purely historical evidence, as the quality of early specimens is more easily explained that way than by assumption of knowledge of the more difficult art of dephosphorisation. That Swedish iron was produced in very large quantities for the time, was exported and possessed a good reputation in the early Middle Ages, must presuppose a long preliminary development. The fact that history is more concerned with copper and silver mining is probably caused by the worship of Mammon, peculiar to all races and times. But there again, we see that the commercial value of iron was very soon realised sufficiently to make Swedish iron, even abroad, an acceptable currency, as Queen Margareta paid a national debt to the Dean and Chapter at Rothschield in Germany with 2400 kegs of iron, &c. &c. With regard to early German influence on Swedish mining, I have pointed out one fundamental difference between the systems adopted in the two countries, and I may add that linguistic similarities may be caused by the early Swedish settlers in northern Germany just as well as by the reverse assumption. A direct importation of German miners during the Middle Ages is, however, known, and the Swedish national hero, Engelbrekt Engelbrektsson was descended in the fourth generation from a German immigrant miner—middle fifteenth century. Any epoch-making foreign influence on progress from foreign sources cannot be said to exist till the time of Gustavus Adolphus, who invited to Sweden Louis de Geer and Marcus Koch, both Dutchmen, about 1627 for improving the iron process and the coinage. The former brought the Walloons with their process, and the latter introduced copper refining, which was previously done in Lübeck. Without entering into any more historical details, I may say that cast iron or pig iron smelting began in Sweden almost a century earlier as well as its refining into wrought iron, but the advent of the Walloon process made Swedish iron, meaning the wrought variety, a household word all over. The process is still used in a few works, and the resulting Walloon iron remains to this day the purest commercial iron known. De Geer also created a name for Swedish cannon iron, and orders for as many as 1500 cannon at a time were placed with him in 1654.

This particular denomination of iron, Swedish cannon iron, is a cold blast pig iron with an exceedingly fine grain, and possessing the strength of bronze. It is now used for the framework of gas engines and for machine foundations having to withstand severe shocks and stresses. As a curiosity, I may mention that the phenomenal strength of this cast iron is believed to depend upon a higher percentage of sulphur than that found in other Swedish iron—something between 0·08 and 0·15 per cent. S of late years. Some time ago I tested the casting behaviour of a parcel, and I found it cast exceedingly well, and the pieces after tooling appeared almost like cast steel, as did the fractures. I also examined its stability of dimensions after repeated heating and cooling, by measuring the distance between punch marks under the traversing microscope, and found it almost unaffected. In history this iron has played a very great part, almost all European countries using small cast Swedish iron cannon under the name of "pièces Suédoises" for field artillery right up to the Napoleonic wars. As I believe that this is very little known in this country, where Swedish iron is synonymous with wrought iron from the Walloon or so-called Lancashire forges, I may be excused for devoting some extra space to it.

For a century and a half after de Geer, the development of the blast-furnace went on uninterruptedly in Sweden until in 1800 Sweden was the largest producer of iron as well as that of the finest qualities in the world. The history of the development during this period is too rich in incident and so brimful of great names that I must confine myself to a scanty outline only. In the political history of Europe, Sweden made a meteoric appearance under Gustavus Adolphus, a veritable *étoile, qui file, qui file et disparait.* The glory was gone in 1718 already politically, but only to make way to an intellectual advance which—let us hope so at least—will never cease. During the Big State period the foundation was laid, the prosaic reason being that money was wanted, and hence the internal resources had to be pumped. Kopparberget struck rich loads and started proper refining by acquiring the mint at Afvesta, and Marcus Koch together. By improved methods and skilful management this, for that time, enormous undertaking paid most of the expenses of the wars. Quite a rich literature exists—including sporadic English works—relating to this period of the history of Kopparberget. Simultaneously, the iron mines and ironworks were strained to the utmost to supply armaments. Methods were improved, and the blast-furnaces grew in height and girth, bringing up the annual output in 1637–1700 to 37,000 tons. Thus the industry grew to respectable dimensions, whilst the ranks of the workers were thinned as never before. Science and literature began to flourish enough to make an international impression, and the ground was prepared when peace and misery came together in 1721.

It is somewhat irksome for the writer as a Swede to point out the importance of the scientific work done by Swedish metallurgists and chemists during the eighteenth century for the benefit of the iron and steel trades of the world. To write the story of this industry without the names of Swedenborg, Brandt, Cronstedt, Rinman, Bergman, Scheele, and others is, however, impossible. Swedenborg is well known as the first critical writer on iron smelting. His description of the smelting of Osmund iron and of steel manufacture by the same process is about the only source of actual information on the subject available, and he has also supplied valuable information on early processes of copper smelting. It is unnecessary to give his history here, as he lived the last years of his life in England and died in London and is on the whole better known in England than in Sweden. He was unfortunate enough to offend his contemporaries by theosophical speculations, and only quite modern investigations have revealed the universal genius behind it all. His many inventions, amongst which there is a practical aeroplane minus the engine, are the subject of much serious inquiry. As a philosopher he was the first of the Swedish school to prove that prolonged study of Nature must lead to the conception of a personal deity and divine interference, and that science and religion are not antagonistic. He and the engineer Polhem did much together to advance mining and public works in Sweden. Brandt and Cronstedt discovered cobalt and nickel as metals (1735–1751), which have an enormous importance in modern metallurgy. Cronstedt also invented a method of making solid platinum metal described in a Swedish book as follows:—"The powder (platinum black) is put in a tube of cast iron and is compressed strongly by means of a steel plunger. Through the strong pressure the powder gains sufficient cohesion to form a short cylinder. When a certain number of such cylinders is obtained, these are subjected to the heat of a porcelain furnace for 30 to 40 hours. Hereby they 'sinter' together and grow considerably smaller after the annealing. At this stage the metal can be forged and used for many purposes, but it is generally hammered to still smaller rods or it is rolled into sheets or worked (drawn) into wire of different thicknesses, &c." As this book was printed in 1873 and refers to the work as done in the 1750–60 period, we have to deal with a somewhat early anticipation of the method used for making tungsten wire. This, by the way, as showing that nothing is new under the sun.

Sven Rinman (1720–1792) was the father of rational iron smelting and the originator of the modern Swedish steel industry. With his contemporary, Thorbern Bergman (1735–1784) he made the blast-furnace process into what it is to-day. The charcoal furnaces made by Rinman are the model used to-day in Sweden, and he made some of nearly as large dimensions as the largest modern ones. He balanced the dimensions of the furnace shaft to suit the crushing stresses of the ore on the charcoal. Bergman, the chemist, taught him and the world how to analyse a slag and how to adjust the slags according to practical assay of the ores. Most interested people know that Bergman was a great metallurgical chemist, but very few indeed know that he invented the method of analysing silicates by fusion with alkaline car-

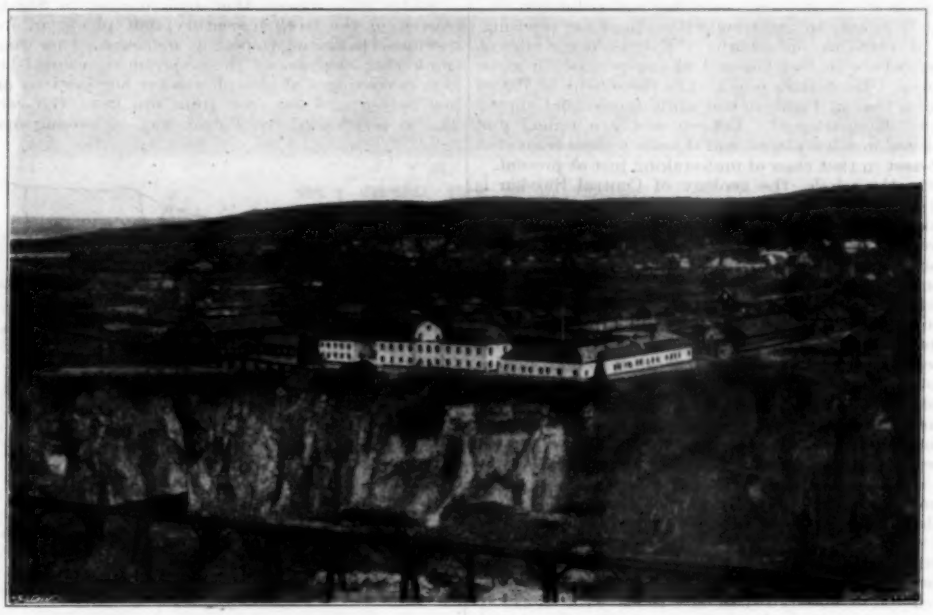


FIG. 4—GENERAL VIEW OF FALUN, WITH MINE AND INDUSTRIAL MUSEUM IN FOREGROUND

bonates, as done to-day. Confession being good for the soul, I may frankly admit that I had analysed many hundreds before knowing it myself, or perhaps realising the universal importance of the invention. The French claim that Lavoisier introduced the balance into chemistry is, of course, untenable, when you consider the work of Agricola, Boyle, and in particular that of Bergman, who separated and weighed the "earths" and expressed them as percentages. Rinman's work on charcoal furnaces made the rational design of coke-fired blast-furnaces fairly easy, as the higher crushing resistance of coke made higher furnaces possible, and the higher temperatures restricted the diameter. He caused Johan Ludvig Robsahm to go to England to find out the secret of steel production by cementation, morally a questionable performance, but practically of great importance. Rinman improved mining machinery to a great extent, and introduced ore conveyors, measuring the ore automatically. His "investigation" of the English process was excusable, as he saw Swedish iron go to Sheffield to be actually re-purchased as the best steel obtainable in those days. That Swedish steel did not take its place depended solely upon the absence of fire-clay for crucibles, on which I have remarked earlier, and the export of Swedish bar iron to Sheffield still remains, maybe for special purposes only, but it remains. The lasting monument of Rinman is his "Bergverkslexikon," or "Dictionary of Mining Works" of 1788.

Dead only four years before his decease his and Bergman's contemporary, Karl Vilhelm Schéele (1742-1786), whose name is imperishable in the history of chemistry, crowded into his short life's work so many discoveries that it would have been strange had he not done anything for the iron and steel industry. His discovery of oxygen anticipated that of Priestley, and he prepared it in many ways from manganese dioxide, saltpetre, mercuric oxide, &c. What interests us most is that he discovered the molybdic and tungstic acids. The former discovery and that of phosphomolybdic acid gave us the reagent for phosphorus, and Schéele investigated and proved the pernicious influence of phosphorus on iron and steel. Even to guess at the monetary value of that discovery is a difficult task; to determine it is impossible. The influence of sulphur was known before, but Schéele gave us the quantitative reagent for its determination by discovering barytes. How much the world owes to that modest apothecary in the modest little town of Köping is for others to say; to me he is one of the many proofs of that inexplicable Divine Destiny which shows Its might through the humblest of implements.

Many other men appeared in Sweden during the eighteenth century, amongst them Linnæus, who, like Schéele, never perceived his own greatness. To him the world owes the systematic notation of what Byron calls "all this visible world" from the largest to the smallest and the idea of the relationship between species even down to minerals. He belongs to the world he described; Sweden was his country by accident only, and the letter L has been written as *his* initial and has been understood as such by more millions of all nationalities than anybody else. In his youth he got the Swedish iron in his mind and wrote his "Iter ad fodinas et officinas metallicas Westmaniæ et Dalecarliæ."

So we see, how all minds in Sweden during the eighteenth century concentrated on the iron, which made and makes that remote corner of the world known wherever civilisation enters. At the close of that century Sweden was the greatest producer of iron in the world and the only country where scientific smelting of that metal was generally known and appreciated. How this position as to quantity was lost, whilst it remained as to quality, will be the subject of my next article.

The Indian Monsoons of 1925.

As affecting engineering works, the Indian monsoons of 1925 were less remarkable than those of 1924, described in THE ENGINEER, March 13th, 1925. They were both, however, of considerable interest as regards their behaviour and effects. The South-West monsoon as a whole was strong in northern India until August 15th, but retreated early from north-west India and remained weak over the Deccan through the season. The total rainfall for the period June to September was in moderate excess in Orissa and the Central Provinces East; in moderate defect in the Punjab South-West, Berar, Hyderabad North and Mysore; and within 20 per cent. of the normal elsewhere. Over the plains of India as a whole it was below normal by 1·6in., or 4 per cent.

The Arabian Sea monsoon appeared on the west coast of the Peninsular on May 27th, about a week earlier than usual, causing some heavy local rains. A break of about a week was followed by rains of fair amount over most of its field, the month of June as a whole being marked by activity less than usual in the Peninsular and greater than usual in north-west India. There was very heavy rain in Orissa and in adjoining parts of the Central Provinces, towards the end of the month, but elsewhere the rainfall was nearly normal or in slight defect, and averaged over the plains of India it was normal. The Arabian Sea monsoon was weak in the Peninsular and fairly active over the rest of its field till July 9th, after which it was maintained in fair strength. The Bay Current, weak and fitful during the first twelve days of the month, later gave abundant rains. The month's total rainfall was in moderate to large excess from Orissa to the east Punjab, in moderate to large defect in Gujerat and the Peninsular, and, averaged over the plains of India, was 8 per cent. in excess. A depression which crossed the Orissa coast on the 11th caused heavy rain in Orissa, and in parts of the Central Provinces and Gujerat; and several breaches were made in the Great Indian Peninsular Railway. A second depression appeared over deltaic Bengal on the 24th, and the almost continuous heavy rains brought by these two depressions caused floods over the greater part of the Cuttack and Puri districts, and extensive damage to young paddy crops. Among the largest total rainfalls for the month, discarding fractions, and taking only those exceeding the respective averages for the stations, were:—33in. at Silchar, Assam; 30in. at Cawnpore; 24in. at Lucknow; 20in. at Agra; 28in. at Subbalpore, Central Provinces West; and 34in. at Mussooree. Notable falls lasting three days or more were:—At Cox's Bazaar, 15th to 19th, 23in.; Chittagong, 17th to 19th, 19in.; while a fall, 12th to 17th, measuring 23in. at Mercara, caused heavy floods in the Cauvery.

The Bay Current was normally active during August. The Arabian Sea branch was vigorous in Malabar, and normal over the rest of India until about the 14th, when it withdrew completely from North-West India. Between the 10th and the 12th there was an unusual concentration of rains along the Himalayas from Kashmir to the north-east frontier. A fall of 6in. is reported to have occurred in a short time on the 10th at Nagpur, causing a flood which inundated parts of Sitabaldi. At Darbhangar a fall of 10in. in twenty-four hours, on the 11th–12th, was followed by a fall of 5in. in the next twenty-four hours. There were floods in the Ravi, Sutlej, Goomti, and Brahmaputra, and in smaller rivers. Parts of Lahore, Lucknow and Dibrugarh were under water, and it was reported that many villages were washed away in the Gonda, Bahraich and Sitapur districts.

From the 14th onwards there was an almost complete break in north-west India, where but little rain fell during the rest of the month. The rainfall for the month was in large defect in Rajputana and Gujerat; in slight to moderate defect over the Punjab, the North-West Frontier Province, the United Provinces, Central India, Bengal and Upper Burma; in slight to moderate excess in Baluchistan, the Central Provinces East, Malabar, and Madras South-East. Averaged over the plains of India, it was 1in., or 10 per cent. in defect. Notable station totals were:—53in. at Mergui, Lower Burma; 30in. at Darbhanga, Bihar; 23in. at Nagpur; and 35in. at Jagdalpur, Central Provinces East.

In September the Bay Current was normally active over most of its field. The Arabian Sea monsoon was extremely weak, and during the first fortnight was almost completely diverted from the Peninsular to the central parts of the country and the Gangetic plain. From the 17th onwards heavy thunderstorms occurred in the Deccan. During the first fortnight three depressions advanced across north-east India. The first brought general rain in the belt of country from the west of the United Provinces and of Central India to Assam and Bengal; the second caused widespread rain in the United Provinces; the third produced heavy rain over the greater part of Bengal. During the second fortnight the Bay monsoon weakened gradually, and after the 24th there were only a few scattered falls in north-east India and Burma. During this second fortnight, thundershowers occurred almost daily in the Peninsular. The rainfall of the month was in slight to moderate excess in Assam, the United Provinces East and the North-West Frontier Province; in moderate defect over most of the Peninsular and in Central India; and in large defect in the United Provinces West and over most of north-west India. Averaged over the plains of India, it was 1·7in., or 22 per cent. in defect. Notable station totals were:—36in. at Moulmein, Lower Burma, and 27in. at Jalpaiguri, Bengal.

The North-East Monsoon.

The North-East Monsoon began in the south of the Peninsular about ten days before the normal date. It was unusually active, and abnormal conditions caused heavy rains also in Hyderabad, Orissa, and Bengal. On October 3rd the monsoon set in fairly vigorously on the Coromandel coast. Heavy rain in north-west Madras was followed by unsettled weather, with more or less widespread rainfall in the Peninsular, Burma and Bengal, locally heavy on the North Madras and Orissa coasts. On the 8th–13th, Gopalpur received 20in. in five days. A depression which had become active by the 16th, caused widespread rain in north-east India and Upper Burma, and the streets of Calcutta were flooded. From about the 20th to the end of the month more or less abundant rain fell in the Madras Presidency. As many as seven disturbances of the winter type affected north-west India, and brought rains of considerable importance. The sixth of these disturbances, October 25th to 27th, caused widespread rains in the North-West Frontier Province and North Punjab; and the last gave fairly heavy rains from north-east Baluchistan to Kashmir. The rainfall of the month was more than eight times the normal from Seistan to Baghdad; six and a-half times the normal in the North-West Frontier Province and Baluchistan; and in large excess in Orissa, the Punjab South-West, Hyderabad South, and Madras Coast North. Totals for stations included:—27in. at Hukitala, Orissa; 11in. at Hyderabad; and 26in. at Gopalpur, Madras Coast North.

In November a depression which had formed off the east coast of Ceylon by the 6th brought heavy and widespread rain in south-east Madras, causing floods in the rivers of the Madura and Tinnevelly districts, landslips on the Nilgiri Railway, and breaches in the South Indian Railway. A secondary brought heavy rain to North Malabar, caused heavy loss of life among the crews of fishing boats and country craft, and damage to property on land. In the south of the Peninsular the monsoon was weak until the 17th, but gave widespread rains during the next three days; after which a more or less dry period lasted till the 25th. There was widespread rain round the head of the Bay and in Upper Burma during the 26th–28th.

The rainfall of the month was in very large excess over most of north-west and central India, and in the United Provinces and Hyderabad North. It was in moderate to large excess in Mysore, the Bombay Deccan and South Madras; in moderate to large defect over most of north-east India, in Burma, the Konkan, Hyderabad South and the Madras Deccan; it was also in large excess at Bushire and Teheran, and in large defect elsewhere in Persia. It must be realised that these figures relate to the normal falls:—Bengal, 1·23in.; Burma, 3·04in.; Mysore, 2·59in.; Madras, 6·67in.; and less than 1in. in the remaining eleven meteorological divisions. The only percentages also important in amount being:—+ 41 in Hyderabad; + 34 in Madras; and − 82 in Burma. Station falls for the month included:—More than 15in. at Cochin and at Trivandrum; nearly 21in. at Tinnevelly; 19in. at Negapatam; 20in. at Cuddalore; 16in. at Madras City; and nearly 13in. at Colombo.

During December an unusually abundant rainfall in Madras caused much flooding, heavy falls on the first two days being followed by widespread rains on the 9th and 10th in the central and southern parts of the Peninsular. A fall of 8·5in. in three hours at Pattukottai in the Tanjore district caused a breach in the railway line, resulting in an accident in which eight persons were killed and twenty-one injured. The fall was a record for the thirty-two years of observations at that station. During this spell of wet weather many of the rivers of south Madras were in flood; some lives were lost, and there was considerable destruction of cattle and property. A rise in the Vaigai caused breaches in the railway line in the Madura district and the flooding of a part of the town. A dry spell from the 12th to the 17th was followed by general rains in Orissa, and there were local falls in the west of the Central Provinces, and adjacent districts of the Bombay Deccan during the last five days of the month. The total rainfall was in very large excess in Mysore and in the Madras Deccan; in large excess over the rest of Madras, in Behar and Orissa; and in slight to moderate excess in some other areas. The total for Madras was 5·85in.; the normal being 2·59in. At Pamban, Madras South-East, the total was 17in., exceeding the normal by 9in., and at Nellore the 15in. recorded was 12in. in excess of the normal.

Dock Extensions at Antwerp.

At the recent Summer Meeting in Belgium of the Institution of Naval Architects, one of the most interesting visits was that paid to the dock extension works at Antwerp. Brief reference was made to these extensions in our issue of July 2nd, both in Monsieur Bollengier's paper on "The Port of Antwerp," and in our description of the visit. Through the courtesy, however, of Monsieur K. Bollengier, the chief engineer and director of harbour works, and of Monsieur L. Bonnet, the engineer in charge of the extensions, who recently described these works in an article published in our French contemporary *Le Génie Civil* of February 6th last, we are now able to give some further particulars and illustrations of this important engineering undertaking. The work of extending the older docks was begun shortly before the war, and was resumed in 1919. The present scheme, which is illustrated in Fig. 1, provides for the construction of a tidal lock at Kruisschans, with a new section of canal dock some 6 kiloms. in length. A new junction canal, 400 m. long, connecting the new canal dock with the old dock system, is also under construction. In order to carry out the new work it was necessary to divert certain small waterways to the north of the dock system, which has now been done. The plan reproduced in Fig. 1 shows the new extensions and the proposed additional wet and dry docks, with the proposed Boerinne entrance lock to the Scheldt, which it is hoped will be constructed at a later date.

The four views given on page 144 show the recent

state of the work, which is at present a little further advanced, so that the sliding gates at the Kruisschans lock are now being built in position. The building of the Kruisschans lock and that section of the canal dock up to the Wilmersdonck dyke, is in the hands of the firm of Dumon et Van der Vin, of Brussels; that section to the south of the dyke is being built by Messrs. Wuytack; whilst the remainder of the canal dock and the connecting channel are being constructed by the firm of Monnoyer et Cie. The estimated cost of the work is about 120 million francs. That figure, however, excludes the cost of the three bridges of the Scherzer lifting type, one of which will be erected at the inner end of the Kruisschans lock and the two others one at either end of the connecting channel. The lifting bridges will have a span of 35 m.

The canal dock varies in width from 300 m. to 400 m., and the depth of water will be about 12 m. concrete, 2 m. in thickness, and is pierced at intervals with holes 20 cm. in diameter, filled with gravel, which allow water to percolate upwards and so relieve any upward thrust. At the heads of the lock and in the recesses for the gates the floor is thickened to 5 m. and strongly reinforced. Sheet piling is also used to prevent infiltration under the foundations. The concrete flooring is carried out to form aprons at each end of the lock, and the banks of the channel are specially protected against damage by the scouring of the water issuing from the two culverts.

The roller gates, which are of a modified Stoney type, are of special interest. They are 36·50 m. in length, with a width of 7·10 m. and a height of 18 m. Each gate is housed in a recess which is 41 m. in length and has a normal width of 10 m. and an entrance width of 8 m. Provision is made for fitting a movable steel cofferdam, 18·30 m. high and 8·80 m. valves of a simple type are also fitted. The dimensions of the culverts and control valves have been fixed with a view to emptying or filling the lock in six minutes, with the most unfavourable conditions of tide. It was particularly necessary, when moving such a large volume of water as 50,000 cubic metres in so short a period of time, to avoid eddying in the lock and undue turbulence in the culverts carrying the water through the lock walls. For this reason the water is led into the lock through a series of twelve apertures, which are built into the side wall of the lock, as seen in Fig. 8. As shown in the sectional elevation reproduced in Fig. 3, these apertures are connected by cross culverts to the two longitudinal culverts, the water flowing through rectangular openings in the floor of the main culvert. The apertures in the side walls of the dock are 4 m. in height, and they have a width of 2½ m. As previously men-

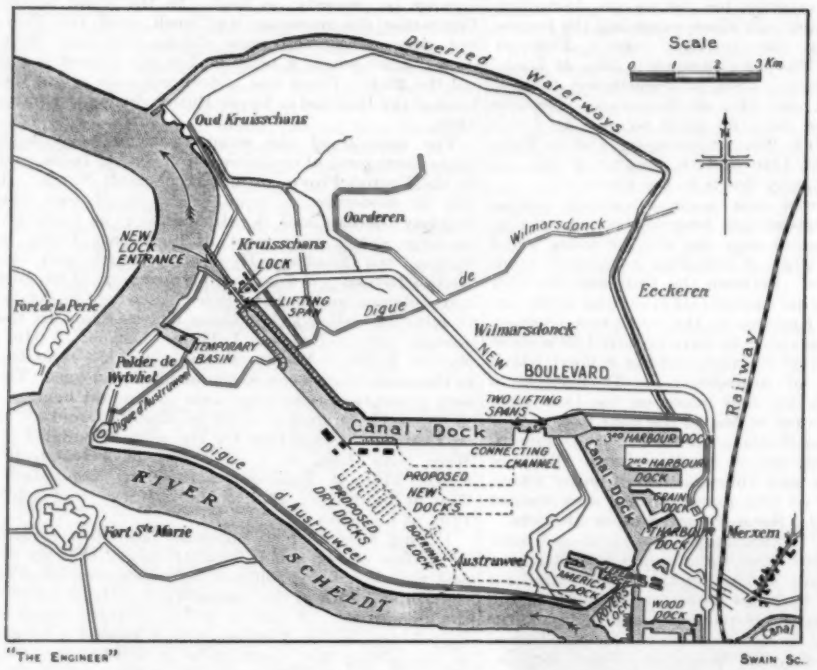
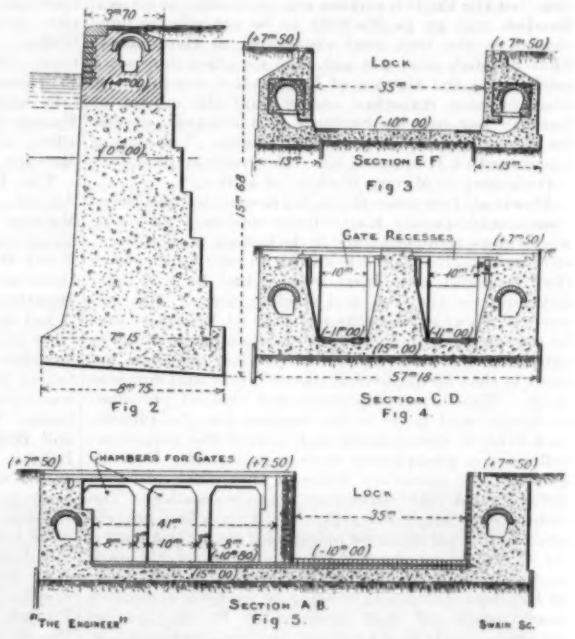


FIG. 1—PLAN SHOWING NEW DOCK EXTENSIONS AT ANTWERP



FIGS. 2 TO 5—LOCK AND QUAY WALLS

In Fig. 10 on page 144 we show part of the canal dock excavation, while in Fig. 2 is given a section through one of the quay walls. The excavation for the canal dock and quay walls has necessitated the removal of about 14,300,000 cubic metres of earthwork, part of which has been utilised in constructing the new boulevard indicated in Fig. 1. For the new work over 650,000 cubic metres of concrete, 4900 cubic metres of wall stones, and 6500 cubic metres of dressed quarry stone have been used. Most of the material was water-borne, and it was unloaded at a temporary basin constructed just below the Kruisschans lock on the Scheldt. The concrete used for the foundations of the quay walls is composed of a mixture containing 250 kilos. of cement and 80 kilos. of trass to 660 litres of gravel and 525 litres of sand. In the mixture used for the upper part of the walls 200 kilos. of cement to 60 kilos. of trass with the same volumes of gravel and sand is employed. The cement is of Belgian manufacture, and both sand and gravel are obtained from the Rhine, while the trass comes from quarries near Andernach in Germany. The work of excavation was carried out without any difficulty. Suction dredgers with special cutters were used, and on some parts of the work it was found possible to utilise portable excavators working in the dry.

The Kruisschans Lock.

The general arrangement of the Kruisschans tidal lock is shown in the elevation sections, Figs. 3 to 5, and in the plan drawing, Fig. 6. The three views on page 144—Figs. 7, 8 and 9—give a good idea of the progress which has now been made. At the time of our visit the floor of the lock was practically finished, a portion of the reinforced apron at the Scheldt end of the lock was approaching completion, and the Stoney type roller gates were being built in their recesses. The overall length of the lock structure is 334 m., and the maximum width over the gate recesses about 100 m. This gives a total length between the two outer gates of 270 m. and about 226 m. between the two inner gates, while the width of the lock is 35 m. The general levels are indicated in the accompanying drawings. In the river Scheldt the lowest tide observed was at a level of − 1 m. and the highest tide + 7·11 m. It will be seen that the level of the top of the wall of the dock is + 7·50 m. and that of the lock floor − 10·00 m. In the canal dock the water level will be at about + 4·00 m., which means that ships can be docked at all states of the tide. The heads of the lock are separate from the lock itself, and they contain the longitudinal culverts which carry the water for filling or emptying the lock. The lock floor is constructed in reinforced in width, in the entrance to the gate recess, so that any gate can be repaired by transforming the recess into a temporary dry dock. The gates are made of steel, and they have four main girder frames, which transmit the pressure of the water to the masonry of the dock, the actual contact being made by baulks of greenheart wood, 40 cm. by 40 cm., attached to the plating. The usual water and air float chambers are provided, and equalising valves, piping and electrically operated pumps are fitted. Each gate is constructed so that it can be moved by mechanically operated roller trucks, or should that method fail, it can be operated as a sliding door, moving on wooden strips resting on polished granite slabs. Roller trucks are fitted at each end of the gate, and each truck carries eight rollers, arranged in two groups of four, one on either side of the gate. The chambers on which the roller trucks are built are connected with an air shaft and air lock, so that the rollers can be inspected under air pressure without having to dry-dock the gate. The gate is moved by an electrically-driven geared tractor unit, mounted on a four-wheeled truck, which runs on rails laid alongside the gate recess on the lock wall. Water jets are provided to remove any silt which may collect in the vicinity of the underwater rollers and rails. Bollards are also fitted at the top of the gate, so that it may be conveniently controlled when floating. It is expected that the time required to open or close a gate will not exceed three minutes.

The water for filling or emptying the lock is controlled by electrically-operated sluice valves of the Stoney type, arranged in the culverts running through the lock walls—see Figs. 7 and 8, page 144. Isolating valves of a simple type are also fitted. The dimensions of the culverts and control valves have been fixed with a view to emptying or filling the lock in six minutes, with the most unfavourable conditions of tide. It was particularly necessary, when moving such a large volume of water as 50,000 cubic metres in so short a period of time, to avoid eddying in the lock and undue turbulence in the culverts carrying the water through the lock walls. For this reason the water is led into the lock through a series of twelve apertures, which are built into the side wall of the lock, as seen in Fig. 8. As shown in the sectional elevation reproduced in Fig. 3, these apertures are connected by cross culverts to the two longitudinal culverts, the water flowing through rectangular openings in the floor of the main culvert. The apertures in the side walls of the dock are 4 m. in height, and they have a width of 2½ m. As previously mentioned, special precautions are taken to prevent damage to the dock and channel walls by the scouring action of the current of water issuing from the culvert openings. Protective aprons built in reinforced concrete are constructed at both ends of the lock, and the banks are strengthened by heaping them with stone work and wood faggots.

The channel leading from the head of the Kruisschans lock to the Scheldt will be 510 m. in length, and its width at the river entrance is to be 375 m., diminishing to about 55 m. near the entrance to the lock. The banks of the channel are protected with stonework and piles, with a foundation of wood faggots. In order to guide the vessels entering the lock a pier some 100 m. long, constructed of pile work, with floating booms, will be built at the entrance to the channel.

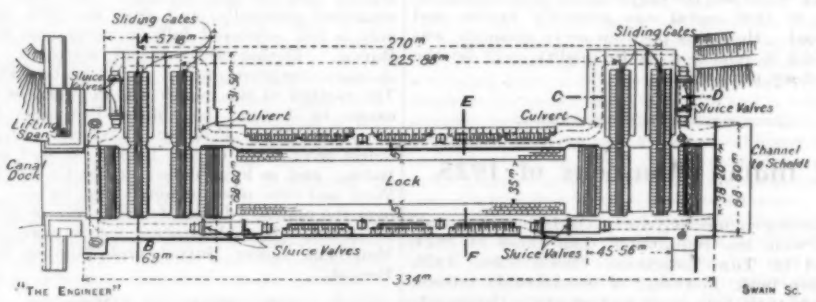


FIG. 6—PLAN OF THE KRUISSCHANS TIDAL LOCK

The excavation for the channel is partly finished, and will be completed by dredging when the works are so far advanced as to allow water to be admitted to the canal dock.

The construction of the lock and canal dock has proceeded without incident. Some clay was met with, but the ground in general consists of a soft fine silt, some of which will pass through a sieve of 3600 meshes to the square centimetre. In the case of the excavations carried down to a depth of 12 m. no difficulty was experienced, and the ordinary methods of drainage were adopted. For the heads of lock, however, where the foundations were carried down to a level of − 15 m., some 22½ m. below the ground level, the underground water was removed by putting down a system of tubes. This same method was successfully used in constructing a barrage at Linne on the Meuse in Holland, in 1919.

At one end of the lock forty-two of these tubes were employed and at the other end thirty-five. They were driven around the site at intervals of about 10 m. apart. Each of the tubes was 15 cm. in diameter and they were in 10 m. lengths, and were driven to a depth of — 22 m. At the bottom end of each tube there was a series of openings covered over with bronze gauze, which was fine enough to prevent sand from passing into the interiors of the tubes. The water was drawn from each tube by an internal pipe, 10 cm. in diameter, which at the head of the tube was connected to a 30 cm. ring main through a stop valve, so that the quantity of water drawn from any given tube could be controlled, and the drainage sectionalised by that means. The water was pumped out by a centrifugal pump, coupled to a 60 horse-power electric motor, and the pumping plant was fitted in duplicate.

The drainage system was, we learn, quite successful, and all the deep excavations were made without any leakage of underground water. At certain periods of the building operations the level of the underground water was kept at — 22 m., whereas that of the deepest foundation was only — 17 m. The works we have described are expected to be completed early in 1928.

Roman Roads.

Since the time of the Romans there has been no parallel either to the existing activity in road building, or in respect of the importance attached to their supervision and maintenance. It is not inappropriate, therefore, to consider the antiquity of a road system which is one of the most conspicuous features of these islands.

If we accept the ancient account, the first paved Roman highway was constructed by Appius Claudius, the Censor, who gave the thoroughfare its name of "Appius" or "Appian" Way. Prior to the time of Appius Claudius, such trunk roads as there were, appear to have lacked those features which we recognise as characterising a Roman road, so that the Appian Way may be regarded as the precursor of that magnificent system from which our own roads originate.

The extraordinary significance attached by the Romans to their roads is well illustrated in the fact that only the most eminent men were counted worthy of being responsible for their maintenance. Plutarch records that the great Julius Cæsar "was made overseer of the work for the highway called Appius Way," and adds that Cæsar spent largely of his own money on works connected with this road. Following him and under the Empire, Augustus himself had charge of all matters pertaining to the roads.

It is not proposed to deal here with such celebrated roads as the Appian Way, the Prænestine Way, the Domitian Way, &c., fascinating as is their technique and history, but rather to comment on the marked development of popular interest in those roads of the Roman Empire which remain the greatest monuments in Britain of an occupation to which we owe so much.

As is well known, the Roman roads in the province of Britain were Imperial roads in exactly the same sense as were the Appian Way from Rome to Brundusium (Brindisi) and the Domitian Way from Sinuessa to Pozzuoli. From the date given in the Itinerary of Antonine ("Itinerarium Antonini Augusti"), it is estimated that the total length of the roads in the Roman Empire was approximately 52,964 Roman miles, the Roman mile being about eleven-twelfths of the English statute mile.

That section of the Itinerary which relates to Imperial roads in Britain contains, as is well known, fifteen "Itinera," and the information set forth in these Itinera is of extreme historical and topographical value, embodying as it does the most important authentic data now extant as to the Roman roads in Britain. There is, indeed, little other contemporary information on this subject, though the laborious research of generations of archæologists has added immeasurably to the slender outline given in the Itinerary.

While the Romans named certain of their roads—particularly those in immediate proximity to the centre of the Empire—there is no reliable record of any names which they may have given to the roads in Britain, and popular titles, such as "Watling Street," "Akeman Street," "Erming Street," &c., are well known to be of a date long subsequent to the construction of the roads thus named. The wording of the Itinerary suggests that the British roads were of the class designated "Iter," an order of road intended for pedestrians and horsemen, but the many examinations made in recent times even on roads—such as the "Fosse"—which did not connect with one or other of the legionary fortresses, show that substantial carriage traffic passed over them. The ruts made by wheels, for example, have been disclosed in many places, and their centres measured.

The date of the construction of the most important of the Roman roads in Britain cannot be placed later than the third quarter of the first century A.D., and in all probability was considerably earlier. That their antiquity—as Roman roads—is of this order, finds confirmation in the fact that the Emperor Claudius was here in 44 A.D. with four legions and their corresponding auxiliaries, a total force approximating, it is estimated, 40,000 men. This great expedition included, besides the Emperor himself, two officers destined to become Emperors, Vespasian and his son Titus.

Every legionary was not only what we should call a heavy infantryman, but he was a sapper besides, and the work of laying out the permanent roads in Britain would proceed simultaneously with the penetration of the country. Moreover, the rapidity and skill with which the Romans constructed fortifications is proverbial, and equally conspicuous is the fact that they usually worked to definite specifications.

It is believed that the Twentieth Legion was settled at Chester within about five years from the date of the Claudian invasion, while the Ninth Legion was established at York by about 75 A.D., say, thirty years after the date of the short visit—he is believed to have remained for only sixteen days—paid by Claudius.

The construction of the roads did not differ in any important respect from the standard construction adopted in and about the Imperial City itself, though the bulk of the materials employed were, of course, those afforded by the districts traversed. While the Appian Way was paved for 120 miles with polygons of lava, the roads in Britain were surfaced, for the most part, either with stone or with selected flints.

As regards foundations, it was the practice of the Roman builders to consolidate the road bed by ramming, and thereafter to build up the mass of the road by superimposed courses. The first of these courses, the "statumen" or foundation, was commonly composed of flat stones laid in mortar. Over

TRANSMISSION LINE CROSSING "FOSSE" ROAD

the "statumen" was a well-rammed course of rubble (the "rudus"), topped with the so-called "nucleus," which consisted of gravel in the proportion of about three parts of gravel to one part of hot lime. The surface—frequently referred to as "summam crustam" or "pavimentum"—was usually of stone paving, well bedded into the nucleus.

These road structures were made to a thickness of about 3ft., and the Roman roads in Britain were usually built to a similar specification, though variations following upon the character of the country traversed are common, and certain of the road structures appear to have resembled the "Vias Terrenas" or unpaved roads, such as were built, from time to time, in other parts of the Roman Empire.

There was never constructed in Britain anything resembling the magnificent streets—"Via Militaris"—which existed in the city of Rome, streets built over the immense sewers which are mentioned by Pliny and ranked by him among the greatest works ever undertaken. Pliny records that so minute was the supervision of these structures that citizens desiring to transport abnormal weights along roads supported by the vaulting over the sewers were obliged to undertake responsibility for any damage which the inspectors of sewers deemed as having ensued from such transportation.

In respect of sheer splendour, there is little likelihood that the Romans or Romano-Britons ever walked in this country on a road surfaced—like the one attributed to Heliogabalus—with green marble and porphyry.

Regarding the methods of surveying, no observer can view the existing Roman roads in this country without admiring the technical ability of those military engineers of antiquity. The popular view that straightness is their chief characteristic does not give sufficient credit to the skill of the men who planned them, since remarkable judgment was shown in so positioning the roads as to afford not only the most direct route, but the one which gave the maximum advantage so far as relates to observation. The fact that the Roman surveyors preferred high ground when an easier alternative might have been chosen arose usually from military considerations.

Straightness is, of course, a very conspicuous feature of these roads, as may be seen from the fact—pointed out by Codrington—that the so-called "Fosse" Road, which, commencing at Lincoln, seems to have penetrated to Devonshire, does not deviate by more than 6 miles from a straight line, approximately 182 miles long, joining the extreme points. South of High Cross, in Leicestershire, there is a stretch of Watling Street which, on a distance of 28 miles along Iter 11 of the Itinerary, does not deviate by more than ¾ mile from a straight line.

Mention of High Cross—the "Venonis" of the Itinerary—brings to mind the circumstance that on this lonely spot, not very far from the centre of England, two of the most important of the Roman roads in this country—"Watling Street" and the "Fosse Way"—cross each other, the site being one which affords excellent opportunity for observing the alignment of the roads between points on high ground.

That the development of motor car traffic should be the occasion for a great revival of interest in our Roman roads was inevitable, but this traffic has, incidentally, been responsible for an extraordinary extension and strengthening of our road system, much of which development has taken place—or is taking place—along the routes chosen by the Romans. This applies, in particular, to "Watling Street" and "Erming Street," roads which support what is possibly the heaviest traffic carried by any trunk roads in this country. These routes have the same importance in respect of road traffic as the main lines of the London, Midland and Scottish Railway and the London and North-Eastern Railway have in respect of railway traffic.

While the magnificent roads herein mentioned are of extraordinary interest to the engineer and the antiquary, the intensity of the traffic over them has tended to obliterate signs of their ancient origin, and few are the passengers who would imagine that the routes over which they are travelling have been in use as civilised thoroughfares for upwards of eighteen centuries.

The accompanying engraving is interesting in that it affords a singular contrast of things ancient and modern. The picture was taken on the "Fosse" Road, in a comparatively remote part of Warwickshire, and the three-phase transmission line which at this point crosses the ancient thoroughfare supplies the power for operating the great British Government broadcasting station at Hillmorton, near Rugby, the most powerful transmitting station in the world.

No one can view the intersection of these respective means of communication without experiencing a stirring of the imagination. The old road—at this point nothing more than a country lane—was an important Roman highway in days when constant traffic passed between Lincoln and other eastern and midland towns, and the great Roman centres at Corinium (the Cirencester of to-day) and Aquæ Sulis (Bath).

Speed over this road would be slow, since, while Julius Cæsar is said to have covered as much as 100 Roman miles in one day, it is on record that Augustus usually halted for the night half way to Prænestе, a distance of about 25 Roman miles, and Horace mentions that on his own journey to Brundusium, a distance of 43 miles, he also halted for the night *en route*, but he states that an expeditious traveller could perform the journey in one day.

To-day, the "Fosse" Road, where it traverses Warwickshire, is hardly used for other than farm traffic, and it presents—for long stretches—an aspect which cannot have been appreciably changed during the eighteen centuries which have passed since it was constructed.

Such a scene as is shown in the engraving can be observed from no railway, but the passenger on the main line of the London, Midland and Scottish Railway who may be interested in the ancient roads of the country does not proceed further than 3 miles from Euston before passing across the track of "Watling Street" at Kilburn High-road, though, curiously enough, the railway at this point runs at approximately right angles to the ancient road.

It is not until he has proceeded for a further 45 miles or so, and reached a point about 1 mile north of Bletchley, that the same passenger again crosses the track of the road, which is there in approximate alignment with the railway, and since the angle of crossing is comparatively fine, a considerable stretch of the road can be viewed—from the railway—in both directions. The line of "Watling Street" is again crossed south of Weedon, where the railway is in tunnel, and re-crossed rather more than a mile north of Weedon Station. From Weedon to Welton, the track of the Roman road runs almost parallel with the railway, the intervening distance being never more than half a mile, until just north of Welton Station the railway crosses the track of the old road at a point in line with the village of Ashby St. Ledgers. There are thus five points south of Rugby where the Roman road is crossed by the railway, and it need hardly be mentioned that deviations in direction are

on the railway, the road being for the most part extraordinarily straight, though north of Weedon it ceases to be part of the main Holyhead road, as laid out by Telford.

Between Rugby and Nuneaton, the main line of the London, Midland and Scottish Railway crosses the "Fosse Road," Brinklow Station being on the actual point of intersection, and at Atherstone, the same line again crosses "Watling Street."

Instances such as these can, of course, be multiplied, but those quoted are sufficient to show that glimpses of the Roman roads are not reserved exclusively for those who traverse them as pedestrians or motorists.

A Boiler Blow-down Accident.

THE Board of Trade has sent to us a report, No. 2788, concerning the explosion of a blow-down tank, with a request that we should give it prominence, and in view of the importance of the matter concerned we are only too pleased to comply. The importance is emphasised in the present case by the loss of two lives, while three other men were injured.

The report deals with an accident in a Bradford wool combing factory which is run by three good-sized Lancashire boilers, that must be worked to their full capacity from Monday morning to Saturday noon to keep the mill running, so that repairs or cleaning can only be effected during week-ends and holidays unless part of the machinery is shut down.

These three boilers are all connected up by a blow down into a common rectangular tank measuring 9ft. by 3ft. by 3ft. 6in., made of $\frac{5}{16}$in. steel plate, as shown in the accompanying drawing, which is taken from the official report. The two connections from the blow-downs are 2½in. in diameter, while there is a 4in. drain to the local sewer and a 4in. vent pipe reaching up above the boiler-house roof. This tank had been tested satisfactorily to a pressure of 45 lb. per square inch, while the boilers are worked at a normal pressure of 140 lb. per square inch. The report goes on to explain that :—

> The boilers were fitted with the usual mountings, and pipes were fitted to each safety valve to carry the waste steam to a range of pipes 4in. in diameter connected to the vapour pipe of the blow-down tank. This vapour pipe, open to the atmosphere, under ordinary working conditions had a non-return valve connected to it about 8ft. above the tank top, as shown in the drawing, so that a pressure accumulating in the tank from any cause whatever would tend to close the valve and so cut off the passage to the atmosphere. This valve was fitted to prevent water in the tank being forced up the pipe and discharged on to the roof of the building.

On February 23rd, Mr. Baxter, the engineer in charge, noticed steam issuing from the vapour pipe of the blow-down tank, and thought the safety valve on No. 1 boiler was leaking. Steam continued to escape all that week, and he arranged to blow out No. 1 boiler on February 27th and to have the safety valve put in order. At 11 a.m. the connecting steam valve was closed down, the fires were drawn, the steam pressure was reduced to 35 lb., the blow-down valve was opened, and at 12.35 p.m. the boiler was about empty. Mr. Baxter then left the works, having previously instructed Mr. Horne, foreman mechanic, to examine the safety valve, grind it in, and afterwards prepare the boiler for steam. The waste steam pipe adjacent to the safety valve was removed and Mr. Horne was satisfied that the valve was not leaking. He decided to examine the safety valve on No. 3 boiler, and told the deceased Leonard Potter, fitter, and Harold Ramsden, labourer, to disconnect the waste steam pipe attached to No. 3 boiler safety valve. This was done, and Potter reported that the valve was leaking freely. The pipe taken off the safety valve of No. 1 boiler was then rejointed. At about 3 p.m. Mr. Horne and Arthur Titman, boiler firer, tried the steam valves on No. 3 boiler and satisfied themselves that the boiler was properly isolated from the other boilers. Mr. Horne gave orders to Potter to draw the fires of No. 3 boiler. This was done, and Ramsden shifted the ashes away from the boiler front and removed the stoke-hold plates covering the blow down valve. The safety valve was not propped open because the waste steam pipe was disconnected. The boiler pressure at 3.30 p.m. was stated by Albert Hugill, assistant engine man, to be 80 lb. per square inch. Potter obtained the key or spanner and placed it on the valve spindle. Ramsden thought that Potter opened the blow-down valve slightly, but was not positive about it. Mr. Horne went into the stokehold just then, and, jumping down to the blow-down valve, took hold of the spanner and opened the valve to its full extent. Immediately the blow-down tank burst with a loud report, and hot water and steam filled the stokehold. Palliser, a plumber, who was standing opposite No. 3 boiler on the ground level, stated that he heard the loud report and was drenched with hot water. He ran towards the engine-house, but returned to the boiler-house to help the others if possible. He was driven back by the scalding water and steam, but going to the top of the boiler he met Titman and removed the weight from the lever of the safety valve, whilst Titman shored the valve open. He was scalded on the wrists and back of neck. Titman stated that he was in the stokehold opposite No. 2 boiler when the explosion occurred. He was struck by a piece of concrete in the face and knocked down. He scrambled out of the stokehold and took cover, but quickly returned to assist the others if possible. He could not get down to the stokehold floor, being driven back by the hot water and steam, but went to the top of No. 3 boiler and eased the safety valve off its seat until the boiler pressure was considerably reduced. Ramsden stated that he was in the stokehold close to the coal elevator when the explosion occurred. He was knocked down by the force of the explosion, but managed to get out of the stokehold. He suffered from contusion and sprains of the back and right leg. Potter's body was discovered on the stokehold floor amidst the *débris*. Mr. Horne's body was found on the top of No. 3 boiler. Steam continued to escape from the boiler for a quarter of an hour.

Upon investigation later it was found that the blow-down tank had exploded, which was probably due to excessive pressure, but the rush of water from the boiler following the injudicious rapid opening of the blow-down valve whilst there was a steam pressure of 80 lb. per square inch in the boiler was probably sufficient to bulge the side of the tank where the column of water struck it. Mr. Horne was most highly spoken of by the partners of the firm, the works manager, and his friend, Mr. Baxter, as a competent, reliable man.

In his comments on the accident the Engineer Surveyor-in-Chief makes the following observations :—

> It is very probable that risk was frequently run whenever these boilers were blown down, the tank into which the contents of the boilers were discharged being of much less strength than the boilers. One of the outlets from the tank had been unwisely fitted with a non-return valve, and was therefore useless as a relief, and the other outlet through which the water was conveyed to the sewer and which was situated near the top of the tank was not such as to afford anything like adequate relief in the event of the pressure in the boiler exceeding the comparatively low pressure which the tank was able safely to withstand.
>
> The bursting of the tank appears to have immediately followed the full opening of the blow-down valve, and, as suggested in the report, it is probable that the projection of the water from the boiler directly against the tank side opposite broke away that side of the tank from the cover, the pressure in the tank completing the entire rupture of the cover.
>
> The owners have now, somewhat late in the day and not till after a serious explosion occurred, fixed a notice in the boiler-house to the effect that "Under no circumstances must the boilers be blown down at more than 20 lb. pressure."
>
> They should also see that the tank is fit to resist safely that pressure, and that it is kept in a proper state of repair.

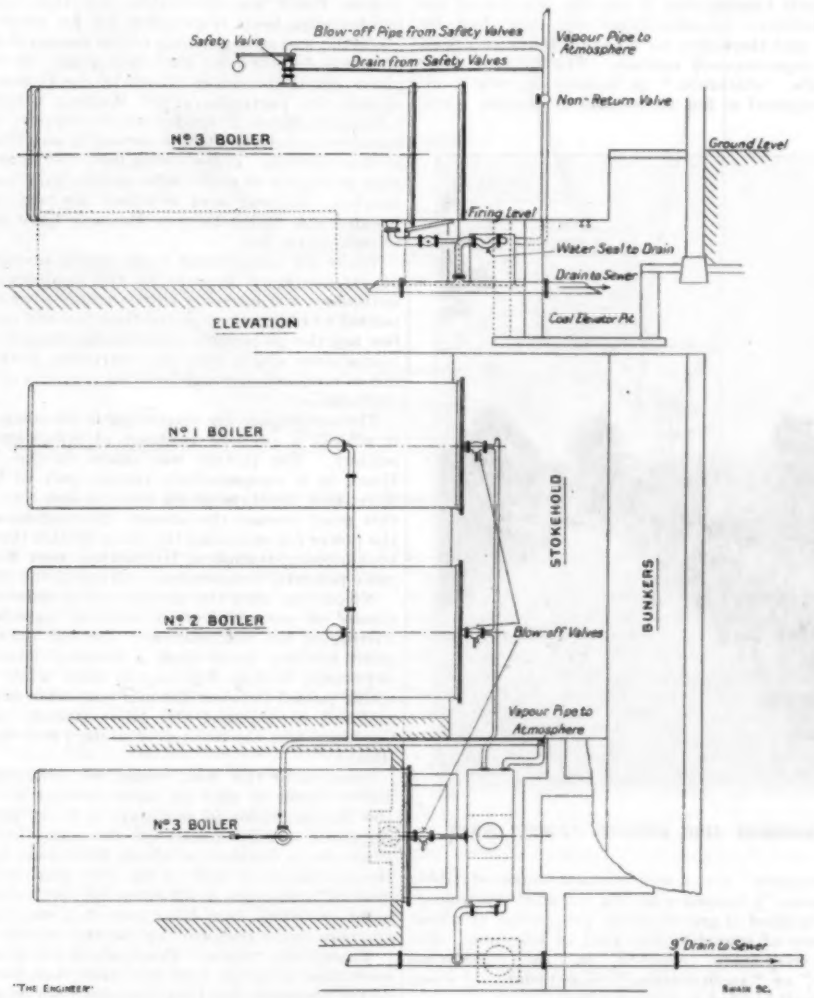


DIAGRAM ILLUSTRATING EXPLOSION OF A BLOW-DOWN TANK

SIXTY YEARS AGO.

SIXTY years ago the third attempt to lay a telegraph cable across the Atlantic was successfully concluded. A cable had been laid from shore to shore in 1858, but it failed after working for a month. In 1865 the Great Eastern was used for a second attempt, but the cable broke and was finally lost when most part of the way across. In the summer of 1866 the same vessel renewed the endeavour, and not only succeeded in landing the cable on the shores of Newfoundland, but later picked up and completed the cable lost during the second attempt. In our issue of August 3rd, 1866, we recorded the completion of the work, but no details had so far reached this country as to the adventures of the cable fleet. We continued to express doubts as to whether the cable having been laid would be found capable of being readily maintained in working order. In addition, we questioned whether the anticipated rate of signalling—generally expressed at twelve words per minute—would be realised. The cable had so far given a satisfactory transmission at the rate of 6½ words, or about 34 letters per minute, and for the reply from the President of the United States to Queen Victoria's message had, apparently by the adoption of all possible means for facilitating the transmission, reached 7·36 words per minute. While all continental Europe was ringing with the roll of the drum and the tramp of armed men, this great work had been completed, and two free nations had been connected by a slender wire. We expressed the hope that by breaking down the barriers of isolation between different nations the spread of long-distance telegraphy would hasten the day when war would be no more, and when we would emerge from our present state of semi-civilisation to one of a higher purity and intelligence. Nearer at hand we might have found an immediate opportunity of reaching a state of higher purity. The summer was a very hot one, and cholera had broken out like a plague. In seven days 1253 people died of it in London, and of them 924 perished in the districts of Bethnal Green, Whitechapel, St. George's-in-the-East, Stepney, Mile End Old Town and Poplar. The region covered by these districts drew its water supply from the river Lea in dangerous proximity to sewers, cuts, and canals full of refuse and foul water. A warning was issued as to the particular danger attached to the drinking of well water. Such water might show no sign by smell, taste or colour that it was dangerously contaminated. On the contrary, wells thoroughly tainted by soakage often yielded water of a peculiarly palatable nature. The most dangerous pumps, it was stated, were frequently the most attractive and, as in the case of the Broad-street pump, had a wide popularity. The spread of rapid means of communication has done at least as much to perpetuate war as to suppress it. We may, however, justly claim that the labours of the sanitary engineer and the water supply engineer have during the past sixty years definitely advanced us on the road to a higher state of civilisation.

THE conclusions arrived at by Colonel Sir John Pringle as to the derailment on May 10th—during the general strike—of the East Coast up day Scottish express at Cramlington, near Newcastle, are (1) that the railway company was taking such measures as were possible, by patrolling the line, to ensure that the permanent way was in order for the passage of trains; (2) that the train in question was travelling at a moderate speed when it was derailed; and (3) that the derailment was due to action by persons unknown who maliciously removed a rail from the track. The report is dated May 27th, and therefore before the Newcastle Assizes at which, as related in this column on July 9th, eight colliers were sent to penal servitude for the offence.

Railway Matters.

According to a message from Melbourne, Mr. Hill, Australian Minister for Works and Railways, has introduced a Bill to authorise the execution of the Commonwealth Government's road scheme, by which it is planned to spend £40,000,000 during the next ten years on roads, of which sum the Federal Government would contribute half and the States the remainder.

The stores department of the London and North-Eastern Railway has been reorganised. Mr. G. F. Thurston continues to be the chief stores superintendent and Mr. C. H. Jeune the assistant chief. Mr. R. C. Richardson, of Gateshead, now joins Mr. Thurston as an assistant, and there are to be three divisional superintendents—Mr. H. A. Butler at Doncaster, Mr. G. P. Benzie at Gateshead, and Mr. A. McIsaac at Cowlairs.

Railway technical literature is the poorer for the death, on July 2nd after an operation, of Mr. George L. Fowler, of New York, whose special field of utility was the design and construction of locomotives. He was associated for many years with the *Railroad Gazette* (New York) and went in 1919 to *Railway and Locomotive Engineering*. Mr. Fowler was a frequent contributor of papers to scientific institutions and to railway associations.

According to the railway returns for 1925, the London and North-Eastern consume the most coal per engine mile and the London, Midland and Scottish the next. In passenger service the rates are :—L. and N.E., 53·11 lb.; L.M. and S., 52·06 lb.; Southern, 45·29 lb.; and Great Western, 40·00 lb. In goods service the quantities are :—L. and N.E., 70·06 lb.; L.M. and S., 65·23 lb.; Southern, 55·80 lb.; and Great Western, 54·82 lb.

The density of the traffic on the underground railways of London is so great that the measure of time in train movements is seconds and not minutes. Thus, as the provision of a motorman in the rear cab at Strand, ready to take over on arrival of the train at Charing Cross—referred to on page 85 of our last issue—saves from 60 to 90 seconds per train, and there are twelve trains an hour, the arrangement is a very economical one.

On page 90 of our issue of the 23rd ultimo mention was made of the inspecting officer of railways' report on a buffer stop collision at Brighton on March 7th. Now, on July 18th, there was another such mishap, and at the Ministry of Transport inquiry last week the driver in that case said that, owing to the curve, he could not see the buffer stops, so judged his position by the buffer stops on the adjoining road. He, however, forgot that the line on which he was running was 40ft. shorter than the other.

On May 1st of last year there was, as recorded on page 545 of The Engineer of May 15th, 1925, a serious disaster at Starogard in Poland to a train running from Germany to East Prussia through the Polish corridor. The event created considerable international ill-feeling, as in Germany it was claimed that the track was being badly maintained by Poland. The matter was referred to arbitration and, according to an award made public a fortnight ago, it was found that the disaster was not due to the bad state of the line, but was the result of foul play. It was added that the condition of the railway left nothing to be desired.

The Ministry of Transport railway statistics for the month of April last have recently been published as a Stationery Office publication, price 3s. 6d. They show that, compared with April, 1925, the number of passenger journeys increased by 1·2 per cent., but as the rise was wholly in passengers at reduced fares the receipts from passengers fell by 3·6 per cent. The increase in the number of passengers was accompanied by 2 per cent. more passenger train miles. There was an increase of 7·1 per cent. in the tonnage of freight carried. The amount of coal, coke and patent fuel was greater than in April, 1925, possibly in anticipation of a probable coal stoppage. General merchandise was, however, higher too. The ton-miles increased by 6·3 per cent. and the goods train receipts by 5·1 per cent. The goods train mileage advanced by 3·1 per cent. and the average train load from 131 to 134½ tons.

In *The Times* of July 24th appeared one of the perennial letters as to the alleged non-necessity for first-class compartments. In view of many persons having that idea, we would say that the proportion of first-class seats to the third class is as one to seven. In September last the average distance travelled by a full fare first-class passenger was 30·51 miles, as compared with 11·69 miles for the third class; the first-class tourist averaged 192·89 miles, as against 137·96 miles for the third class; the first-class season ticket holder went, on an average, 13·42 miles, as compared with 9·57 for the third class; and the first-class traders' ticket covered 45·61 miles, as against 46·68 for the third class. The charge was also made that the disparity between the two fares is too high. That that is not so will be seen when it is noted that the average amount per passenger mile for full fare was 2·445d. for first class and 1·316d. for third. The difference in the tourist, season and traders' tickets was less still.

Among the interesting miscellaneous information contained in the recently published railway returns for 1925 we find that out of nearly 75 million parcels conveyed by rail the London, Midland and Scottish carried over 31 millions, the London and North-Eastern 20 millions, the Great Western 12 millions, and the Southern 8½ millions. The receipts from newspapers were £1,693,055, of which the L.M.S. had £677,896 and the L.N.E. £427,332. Milk is returned in quantities of gallons and number of cans. There were nearly 278 million gallons, of which the L.M.S. carried 94½ million gallons and the Great Western nearly 85 millions. The cans numbered 21 millions, of which the L.M.S. had 7¼ millions and the Great Western 6 millions. When it comes to meat the Southern is found to have carried 53,153 tons out of the total of 83,843 tons. That is accounted for by the traffic imported through Southampton docks. Of the cheapest rated fish the London and North-Eastern carried 274,000 tons out of 473,738 tons. The Great Western apparently has the cream of the motor car traffic, as it conveyed 3801 truck loads out of the total of 5902, but the money received was only £6698, as compared with the London, Midland and Scottish sum of £10,400 for 1720 trucks.

Notes and Memoranda.

A steam turbine which has been installed in the plant of the Trinidad Electric Transmission, Railway and Gas Company has been so constructed that while it is initially worked at a pressure of 165 lb. per square inch and 100 deg. Fah. superheat, it can subsequently be changed to run with steam at 350 lb. and 700 deg. For the higher pressure, fourteen stages of blading will be required, but only nine of the stages are being used.

An article in the *Chemical Engineering and Mining Review* by Mr. C. M. Harris gives some idea of the handicaps of mining in north-west Australia, caused by lack of transport facilities. An example is as follows :—Carting the ore from Ragged Hill by camels to a depôt—14 miles—over rough country to the depôt where it is picked up, 25s. per ton; by motor wagon, 90 miles to Coongan, 140s.; railage to the coast, 30s.; and freight, &c., to Fremantle, 25s.; making a total of £11 per ton, without the cost of mining, development, bagging ore and management.

A committee which presented its report of an investigation of the effect of phosphorus and sulphur in rivet steel at the annual meeting of the American Society for Testing Materials, drew attention to the fact that the sulphur present in commercial rivet steel up to at least 0·06 per cent. is not detrimental, the tests showing no systematic relation between any of the physical properties determined and the sulphur content up to that limit. With the sulphur content above approximately 0·06 per cent., the values of certain properties decrease with the increase in sulphur content.

According to Mr. S. G. Highland, of the Clarksburg Water Board, W. Va., water pipes in northern and north-eastern America should be laid at a depth of at least 12ft. to escape being frozen. At Moose Jaw, Saskatchewan, frost penetration reaches a lowest depth under roadways, where the soil is firmly compact. It is less in boulevards and on private property, where the soil is looser, and often protected by grass. In these latter places the frost penetration is about 2ft. less than in the abutting streets. Frost penetration is greatest in wet clay soils, and 50 per cent. less in sandy soils.

A two million-volt transformer set, twice as large as any previously built, has been supplied to the Leland Stanford University, by the General Electric Company of America. Looking forward to the time when power must be transmitted for hundreds of miles to meet the demands of the San Francisco territory, this set was ordered by the University so that it can solve the problems of high voltage transmission well in advance of requirements. The transformer set had been in the process of construction for more than two years under the direction of Mr. Allan B. Hendricks, electrical engineer, who was responsible for its design.

In the course of an article on "safety first" in blowing-out a blast-furnace, appearing in *Mining and Metallurgy*, Mr. E. P. Ross suggests that risks of explosion may be avoided by filling up with coke during the "blowing out" process; that is, keeping the furnace full of coke while emptying it of the iron-bearing materials, &c. A poor quality of coke can be used, and coke breeze or ashes filled toward the latter end to hold up the pressure in order to get out the last cast. Even if good coke be used, it can be cooled down and drawn out at the tuyeres and used over again. In this way there is no large cavity to fill with explosive gases.

In the course of his address, when opening the new engineering and metallurgical laboratories of the Sheffield University, Sir Robert Hadfield said that from some information which reached him recently through Professor C. Francis Harding, Head of the School of Electrical Engineering at Purdue University (Indiana), with reference to the application of electric heating to the hardening and tempering of steel, it has been proved by exhaustive experiments that electricity at ¾d. a unit is equivalent to oil at 3d. a gallon—50s. to 56s. a ton—and gas at 2s. per 1000 cubic feet. The particular application concerned relates to the heat treatment of automobile gears by a large manufacturer, who stated that, in view of the more uniform results obtained, he would prefer electric heating.

So large was the armature for a 40,000 kilovolt-ampère frequency changer recently shipped from the Schenectady, N.Y., works of the General Electric Company, that it was necessary to provide special right of way over the Delaware and Hudson Railroad at Albany. This armature weighing 226,000 lb., is 13ft. in diameter and 20ft. long. The maximum railway clearance is 10ft., so that it was impossible for a train to pass this apparatus on either side. Shipment of the apparatus was made from Schenectady early Sunday morning, May 16th. The tracks on both sides of the Delaware and Hudson Railway were made clear of cars all of the way from Schenectady to Albany. It was also necessary for the General Electric Company to remove the windows from above the doors in the building in which the armature was constructed, and also to remove the gates to the yards before the apparatus could be delivered to the Delaware and Hudson Railway.

In the *General Electric Review* (U.S.A.), Mr. A. W. Tupper recently gave an account of a form of navigation light, now being used on the rivers and lakes of the United States, but not very familiar in this country—the unattended flashlight deriving its current from primary batteries. The form generally used consists of a small insect-proof lantern having a Fresnel lens of about 6in. in diameter, a 0·5 ampère 10-volt lamp and 14 to 16 Edison primary cells of 500 ampère-hour capacity. About thirty single flashes per minute of about ½ second duration are given. The "flashing" gives a distinctive character to the light and renders the use of red glass, with its high absorption of light, unnecessary. It has also the advantage of extending the battery life, which under these circumstances is about 320 days. These lights can be left unattended for long periods, and the consumption does not exceed 5 to 10 watts per light. This corresponds to a range of from 5 to 8 miles for cylindrical lenses, and 14 to 16 miles with reflectors of the headlight type. There are about 50 to 60 of these primary battery lights now in use by the U.S.A. Lighthouse Service and, whilst subject to obvious limitations, they have a distinct field of utility.

Miscellanea.

A paper pulp factory is to be established at Geeviston, Tasmania.

The first steel rails made from South African pig iron were rolled at Vereeniging on July 7th last.

It is reported that the miniature aeroplane made by the Ford Company weighs only 350 lb. It has a span of 22ft. and is capable of a maximum speed of 85 miles per hour.

The eighth of the series of popular Model Engineer Exhibitions opens on September 17th at the Royal Horticultural Hall, Westminster, closing on Saturday, September 25th.

During 1925 Canada produced 13,134,968 tons of coal, valued at 49,261,951 dollars, a decrease of 3·5 per cent. in quantity and 8 per cent. in value, according to a report issued by the Dominion Bureau of Statistics.

Some of the largest boilers in the Lots-road power station of the London Underground Company have been so equipped that they can be quickly changed over for burning oil fuel in the event of coal supplies running short.

It has been decided that the floating dock which is to be built by the Commonwealth and the New South Wales Governments, at Walsh Island, shall be of 15,000 tons lifting capacity, instead of 13,000 tons, as originally arranged.

During June only one vessel was launched on the Tyne, as compared with five twelve months before, making sixteen launched in the first six months of the current year, as compared with thirty-one from January 1st to June 30th, 1925.

The new Lobnitz rock cutter has arrived at Sydney Harbour and has been put to work. It is equipped with a dropping cutter weighing 15 tons, which can be dropped from a height of from 6ft. to 10ft. Its work is the deepening of the harbour berths.

The Trustees of the Busk Studentship in Aeronautics, founded in memory of Edward Teshmaker Busk, who lost his life in 1914 whilst flying an experimental aeroplane, have awarded the studentship for the year 1926–7 to Mr. Percy Brooksbank Walker, B.A., of Peterhouse, Cambridge.

Returns from Clyde shipyards show that during July twelve craft of 12,897 tons gross measurement were launched, as compared with thirty-four ships of 31,645 tons for July last year. The output for the seven months was eighty-seven vessels of 170,720 tons, and for the same period last year the figures were 153 ships of 334,979 tons.

A selection of the work received in the Royal Society of Arts' competition of industrial designs is being exhibited, by permission of the Board of Governors, in the Upper East Gallery of the Imperial Institute, South Kensington, up to August 31st next, every weekday from 10 a.m. to 5 p.m. The exhibition is open free of charge, no tickets being required.

A contract has been signed between the Government of Bolivia and Marconi's Wireless Telegraph Company, Ltd., whereby the latter will, as from October 1st, 1926, control and operate for a period of twenty-five years the postal telegraph and wireless services of Bolivia on the basis of a percentage of the gross receipts of the services as remuneration for management, plus a proportion of the profits when there may be a surplus.

A 25,000-ton floating dock, under construction at the Hamburg yard of the Vulkan Works, for the French Government, was launched on July 10th. This dock is intended for the Port Autonome at Bordeaux, and has the following measurements :—Extreme length, 220 m.; length over pontoons, 206 m.; width over sill (top), 36 m.; width over sill (bottom), 34 m.; depth of base pontoon, 8·80 m.; maximum lifting capacity, 25,000 tons. The dock is built to take vessels of 8·80 m. draught and is fitted with six electrically operated pumps, which are designed to raise the dock in 120 minutes.

A motor car equipped with a new gear-shifting device, which, it is claimed, totally eliminates the ordinary gear-changing methods, recently completed its initial run from Boston to New York. The device is worked by vacuum from the manifold of the car, the operating mechanism being placed beneath the steering wheel and being operated by the foot. After releasing the clutch and starting the car, the gear changing can be effected by a slight pressure on an operating lever for first, second, and third speeds forward, neutral and reverse—five changes—a touch only being necessary for the required change.

The Union Minière Katanga is, according to the *South African Mining and Engineering Journal*, concentrating all its efforts at Panda, where the big lixiviation plant is ultimately to produce 90,000 tons of electrolytic copper annually. The central power plant of 10,000 kilowatts is to be trebled. An ore-reducing plant, which is also under construction there, comprises three reverberatory furnaces which will produce 30,000 to 40,000 tons of copper yearly. The first furnace will be lighted during the second half of this year. In addition, a third works, to treat ore by flotation, is to be erected in the neighbourhood. As a result of these measures, it is anticipated that production will be increased to 200,000 tons within two years and a half, if labour difficulties are settled.

The construction of the Book Tower in Detroit, which will rise to a height of 873ft. above the ground, and will be the tallest building in the world, was started recently with the razing of the buildings that occupied the site on which it will stand. The new building will have eighty-five floors, four of which will be underground, which will give it twenty-three floors more than the Woolworth Building in New York City, at present the world's highest building. The structure will, according to the *Contract Record and Engineering Review*, have a 225ft. frontage on State-street, 120ft. on Washington-boulevard, and 180ft. on Park-place. The main building will rise forty-two storeys above the street, each floor containing 230,000 square feet of space. Above the building proper the tower will rise 120ft. by 125ft. The construction work will be of steel and concrete, and the exterior will be of marble and granite combined with light buff brick.

NEW DOCK EXTENSION WORKS AT ANTWERP

(*For description see page* 139)

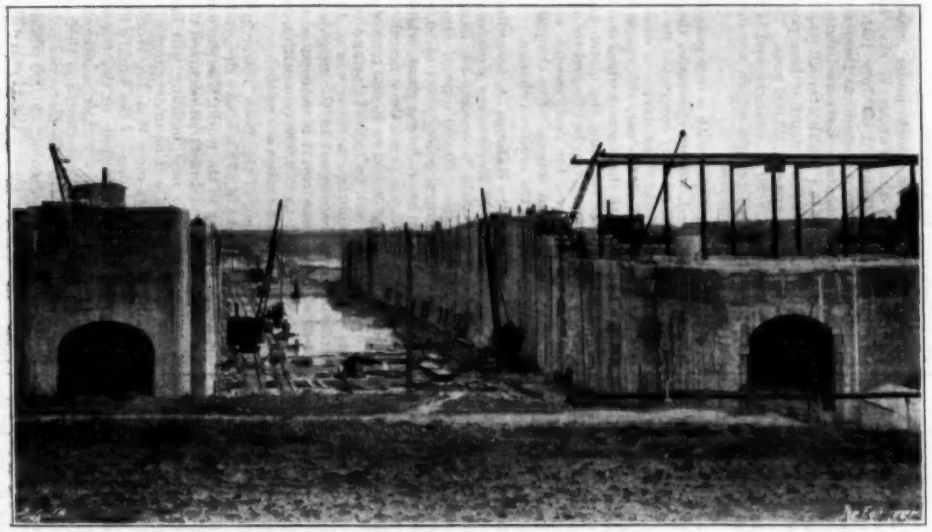


FIG. 7—THE SCHELDT END OF KRUISSCHANS LOCK

FIG. 8—VIEW OF LOCK SHOWING SIDE CULVERTS

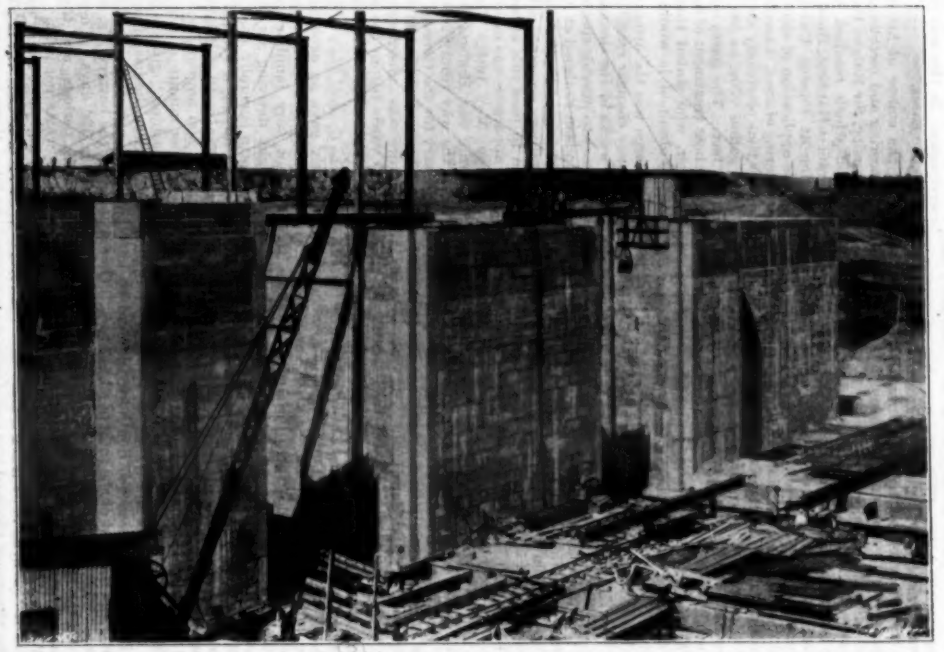


FIG. 9—GATE RECESSES AT THE HEAD OF THE LOCK

FIG. 10—VIEW IN CANAL DOCK SHOWING CONCRETING IN PROGRESS

AGENTS ABROAD FOR THE SALE OF

The Engineer

BUENOS AIRES.—Mitchell's Book Store, 576, Cangallo.

CHINA.—Kelly and Walsh, Limited, Shanghai and Hong Kong.

EGYPT.—Cairo Express Agency, near Shepheard's Hotel, Cairo.

FRANCE.—Boyveau and Chevillet, Rue de la Banque, Paris.
Chapelot and Cie., 136, Bld. St. Germain, Paris.

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DEATH.

Tuesday, July 27th, Herbert Hunt, founder and senior partner of Herbert Hunt and Sons, engineers, of Old Trafford, Manchester.

THE ENGINEER.

AUGUST 6, 1926.

Naval Aviation.

To say that aviation is destined to play an important part in future warfare at sea is to utter a platitude. Aircraft have already become an integral component of every well-balanced fleet, and their unique value has been demonstrated in actual war operations. In the development of this new arm the British Navy may claim to have led the way. While there is some doubt as to whether an aeroplane was first flown from the deck of a British or an American man-of-war, it is not disputed that we were the first in the field with the aircraft carrier, which has made possible the remarkable progress in naval aviation. At the beginning of the war several cross-Channel steamers were converted into aeroplane carriers, one of which did useful service at Jutland. Then the Cunard liner Campania was fitted with a flight deck, from which machines could take off, though they were unable to make landings on it. The next stage was the conversion of the light battle-cruiser Furious, which became the prototype of the modern carrier. She proved a great success, and it was from her deck that the most successful naval air attack of the whole war was launched, when a flight of machines bombed the German airship sheds at Tondern, destroying two Zeppelins. Meanwhile, the Admiralty had purchased the Chilean battleship Cochrane and the Italian liner Conte Rosso, lying unfinished in British shipyards, and caused them to be rebuilt as aircraft carriers, under the respective names of Eagle and Argus. Finally, in January, 1918, the Hermes was laid down, she being the first ship in the world to be designed *ab ovo* for the transport of aircraft. Since the war the two battle-cruisers Glorious and Courageous have been taken in hand for conversion. The result is that we now possess a fleet of carriers of which there is no counterpart in any foreign navy. Excluding two that are obsolete, it consists of six vessels, ranging from 10,550 to 22,600 tons. The Argus—the slowest unit—has a speed of just over 20 knots; the Eagle is good for 24 knots; the Hermes for 25; and the Furious, Glorious and Courageous for 31 knots. The combined aircraft capacity of these six ships is not definitely known, but it cannot be less than 160 machines.

Turning to other navies, the United States is first with two very large carriers, Lexington and Saratoga, originally begun as battle-cruisers. The displacement is 33,000 tons, the designed speed 33·34 knots, and the stowage capacity seventy-two aeroplanes per ship. Unlike our carriers, which mount nothing heavier than 6in. guns, the American type is very powerfully armed, having eight 8in. 55-calibre guns in twin turrets, twelve 5in. quick-firers on high-angle mountings, and four torpedo tubes. It is, in effect, a composite type, half battle-cruiser and half aircraft carrier, its combatant character being further emphasised by substantial belt armour and bulge protection. Japan is pursuing much the same policy. Her largest carrier, the former battle-cruiser Akagi, of 27,000 tons and 28·5 knots, mounts no fewer than ten 8in. and sixteen 4·7in. guns, and it is understood that the Kaga, an ex-battleship, of 26,900 tons and 23 knots, will have a similar armament. It will be seen that H.M.S. Eagle, our largest ship, is smaller by 10,400 tons than the American type, and is considerably lighter than the Japanese vessels. In British naval circles, however, the utility of such monster ships is questioned. Logically considered, the carrier is not a fighting ship but an auxiliary; her prime function is to furnish a floating base for aircraft working with the fleet. Being peculiarly vulnerable to gunfire and other methods of attack, she should keep as far away from the enemy as is consistent with the performance of her special duties. Otherwise, the necessity of affording her protection will impose a serious burden on the fighting ships proper. Moreover, the sinking or disablement of a carrier such as the Lexington or the Akagi would be a disaster of the first magnitude, since it would deprive the fleet to which she belonged of half its air force at a single blow. Hence the preference in this country for carriers of moderate dimensions, such as the Hermes. The reconstruction of such comparatively large vessels as the Glorious and Courageous is probably dictated by motives of economy. Had funds been available, new ships of smaller tonnage would doubtless have been laid down. But, although American policy with regard to carrier dimensions may be open to criticism, there are other features of aviation development in the United States Navy which seem to us worthy of emulation. We refer particularly to the principle of supplying aeroplanes to every type of vessel capable of carrying them. According to recent information, every American battleship in the fleet now carries one scout and two combat machines, and each cruiser two scouts. They are discharged from the ship by means of catapults. During the visit of the United States light cruiser Memphis to Gravesend this month we had an opportunity of inspecting her aircraft equipment. The two seaplanes were stowed amidships, each on its own catapult. Certainly they occupied a good deal of deck space, but their presence did not seem to interfere with the effective working of the ship or her armament. We were informed that flying exercises were part of the ordinary routine of training, and that no difficulty was experienced in launching the machines in normal weather. They are propelled from the catapult by an air blast at a velocity of 60 miles an hour. On returning from the air they alight on the sea as close to the ship as possible, whence they are hoisted in by the derrick. By constant repetition the operation of launching the machines and recovering them from the sea has been brought to a high standard of efficiency. Seaplanes of a diminutive type have been designed for the use of destroyers, and twenty of these boats now carry one machine apiece. Even submarines have been experimentally fitted with tiny seaplanes. In all, something like a hundred aeroplanes are now distributed among the ships of the United States Navy, in addition to those borne in the carriers. The battleships use their aircraft chiefly for "spotting" purposes, and are thus able to acquire practical experience in long-range indirect gunnery. Cruisers detailed for patrol or reconnaissance must find their aircraft invaluable. Had our cruisers been equipped with aeroplanes on the outbreak of war, it is virtually certain that all the German raiders then at large would speedily have been laid by the heels. The career of the Emden, Karlsruhe, and others would have been numbered by weeks or even days, instead of by months. At that period, however, reliable aircraft for use on board ship had not been evolved, and so our cruisers had to dispense with what would assuredly have proved an adjunct of priceless value. But by now the most serious technical difficulties have been overcome, and it is to be hoped that the Admiralty will not be behindhand in providing aircraft for such of our warships as could employ them with profit, that is, battleships and cruisers.

The American Navy enjoys one marked advan-

tage: it has absolute control of its air branch, which is thus organised strictly in accordance with naval needs, no other Department having a voice in the matter. In time, as we hope, this rational system will be introduced here, and the Navy's flying service divorced from Air Ministry control, which acts as a drag on the wheels of progress. Convincing evidence of the importance attached to aviation by the American naval authorities is afforded by recent legislative action. A Bill which passed through Congress last month, and has since become law, authorises the expenditure of £17,000,000 on the naval air service during the next five years. It provides for the construction of 1947 new aeroplanes and the maintenance at all times of an effective force of not less than 1000 machines. Lighter-than-air craft are to be represented by two rigid dirigibles, each to be three times as large as the ill-fated Shenandoah. Not the least important section of the Bill is a clause which creates the post of Second Assistant Secretary of the Navy, whose sole duty will be the administration and supervision of the air arm. It is further enacted that every officer appointed to command an aviation school, a flying station, or an air unit shall be a qualified aviator. Thanks to this far-reaching measure, the future of the American Navy's air service would seem to be assured On the other hand, though the present strength of the British Navy in aircraft is difficult to estimate in the absence of reliable figures, we believe we are correct in describing it as inadequate even for the needs of the moment. There should, we submit, be enough machines on hand to fill up all available aircraft carriers to capacity and to provide at least two for every battleship and at least one for every cruiser on the active list, with a literal margin in reserve. No doubt the Admiralty is doing its best to attain this standard, but there are obvious difficulties in the way, not the least of them being the well-meant efforts of the Air Ministry to balance the conflicting claims of the Navy, the Army and the Royal Air Force itself. We shall not presume to decide between the claims of these respective services, but we are definitely of opinion that the formation of an adequate and autonomous Naval Flying Corps is a national requirement of capital importance.

A Continental Steel Combine.

During the past three years or more steel makers on the Continent have been carrying out negotiations for the constitution of a union which should regulate production to the demand, and put an end to a competition for business that was threatening to ruin the industry. The idea started in Germany, where the steel firms affected to see peril in the possible dumping of American steel products in Europe. It was hoped to organise European productive forces against competition from the United States. It is true that during the years following the Armistice, American activity on this side appeared to warrant the apprehension of continental steel makers, who found that their own means of action were too much dispersed to resist any outside organised effort to secure European trade. The fear has not been justified, for the United States consumption has been growing sufficiently to absorb the increasing production of steel in that country, and if the continental union is still necessary, it is due to a considerable development of the steel-making industry which has far outstripped a stationary demand. The weakness of the situation lies in the fact that there is very little business to be done in markets outside Europe. Countries which formerly took large quantities of steel are now manufacturing themselves. Nevertheless, it cannot be said that the markets are entirely lost, for it is reported that Japan is now purchasing steel in Germany because it costs less than the steel manufactured at works installed in that country by American firms. A steel-making industry cannot be created successfully under conditions in which the cost of transporting raw material is much more than the freights on the finished product. If the metal can be sent to Japan at below the cost at which it can be manufactured there, it is possible that some of the overseas trade may be recovered. For the moment, however, European makers still find themselves confronted with the problem of keeping down the production to a definite rate of consumption, and at the same time they have to adjust prices to varying currency values. When countries like Germany and France compete for business, the results are bound to be disastrous. With their gold currency the Germans know exactly what they can do, but the French cannot possibly fix any safe limits so long as they base quotations on fluctuating values, and they are nearly always tempted to quote prices which they find eventually are unprofitable. The Germans are therefore obliged to cut their profits very fine, and even, on occasion, to sacrifice them altogether, with the result that there is a general complaint of the steel industry showing a loss all round. French and Belgian makers are fully alive to the difficulty of carrying on business under present conditions. They are as anxious as the Germans to come to an agreement which will mean, practically, that all business will be transacted henceforth on a gold basis. There will be no competition, and consequently German prices can be applied to business done in foreign markets.

The statement published to the effect that the Steel Union, comprising Germany, France, Belgium and Luxemburg, has been definitely constituted, and that the final agreement will be signed at Dusseldörf next week, appears to be premature. It is true that the countries named have settled upon the main lines of the agreement, and have fixed their respective quotas, but each country has now to arrange for the distribution of its share of foreign orders amongst the home firms. There has been no difficulty in settling the participation amongst French and German steel makers, but in Belgium it has not yet been possible to arrive at a settlement. Nevertheless, it is hoped that these details will be adjusted in time to permit of the agreement being signed at the Dusseldörf meeting. The negotiations have passed through so many vicissitudes on account of the difficulty of reconciling the interests of all concerned, that their successful issue is having a distinctly favourable influence upon the continental steel trade. Each country now knows that the home market is safe, and that it is assured of a profitable, though limited, participation in the foreign trade. It is also expected to be helpful in removing the many other difficulties that have been created by the re-adjustment of steel-making resources on the Continent, such as the exchange between France and Germany of iron ore and coke, and the supply of metallurgical products to Germany from Lorraine and the Saar; but these are matters that can only be settled by a treaty of commerce, which is a far more laborious and protracted undertaking than the Steel Union. The re-adjustment of metallurgical resources in Europe has also had the effect of arousing a protest from Poland against being excluded from the new combination. The annexation of Upper Silesia has made Poland an important producer of steel, and negotiations are now in progress for giving to that country a proportionate quota of foreign trade.

At the time suggestions were first made for the formation of the Steel Union, it was hoped to bring British makers into the combination. Apart from the reluctance of British firms to adhere to continental agreements, unless they are quite unavoidable, it is doubtful whether an understanding could have been come to over the participation in foreign business. The difficulty was serious enough in constituting the Rail Union. The continental makers had to accept a compromise which gave them the illusory advantage of preserving a principle, while it excluded them from the Dominions until the British rail makers had secured their full quota of foreign trade. It is doubtful whether the same compromise would have been possible in the case of the steel-making industry. The question therefore arises as to what extent the Steel Union will affect the interests of British makers. On the Continent it is claimed that the agreement come to will enable producers to secure higher prices for foreign business, and thereby allow of steel products being sold to home consumers at lower rates. The principle is obviously sound, and is conducive to national prosperity, so long as there is no outside competition. It is, nevertheless, to be presumed that continental steel makers do not consider that British competition can be ignored. At the same time, makers on the Continent have certainly an arm against that competition if it should become troublesome. British steel producers may feel themselves secure if continental firms adhere to their principle of enabling home consumers to profit from the higher prices they obtain in foreign markets. The immediate effect of the Rail Union operations, however, does not appear to confirm the practical character of this principle. In France the Union was strongly opposed by the railway companies, which feared that they would have to pay much higher prices for their rails, an apprehension that was fully justified, for contracts are now being given out at advanced rates, and the companies seem anxious to place additional orders in view of a further advance. This is certainly due largely to the monetary depreciation and to the necessity of adjusting prices on a profitable basis; but it shows, nevertheless, that the Union has strengthened the hands of makers, who are now better able to control prices without fear of outside competition. As steel makers will, in the same way, control their own markets, there will be nothing to prevent them from violating their principle and offering steel to be worked up for export at specially low prices at the expense of home consumers, if that should become necessary. British makers will therefore find continental competition in no way attenuated by the new steel combine. It becomes more effective by organisation, but less dangerous, because makers know exactly the limit to which they can go in cutting outside prices. That limit is fixed by the prices they can obtain on the home market. Continental producers have shown that they are alive to business possibilities in the Dominions, from which they are not practically excluded in the same way as are the rail makers. Possibly, the future will bring about further developments in the steel combine.

British Association.

No. I.

The meeting of the British Association for the Advancement of Science, which opened at Oxford on Wednesday, and will not terminate until Wednesday next, is a somewhat noteworthy event in the history of this pioneer among scientific organisations. The fact that the Prince of Wales is this year occupying the position of President has attracted an attendance of about 4000 persons, and the influx has severely taxed the accommodation of Oxford. It was impossible to find room for even half that number in the Sheldonian Theatre, where the presidential address was delivered on Wednesday evening, and the address was therefore transmitted to a second audience at the Town Hall, and was included in the general broadcasting programme. Many distinguished men of science have occupied the presidential chair, but only once before, at the Aberdeen meeting held in 1859, when the Prince Consort occupied the position, has it been held by a member of the Royal Family. It is not a disadvantage that on rare occasions such as the present the Chair of the British Association should be occupied by an eminent public man who is not a scientist, and who can therefore represent the citizens of the world at large who benefit by the achievements of, without themselves contributing to, the advancement of science. Nor is it inappropriate that this particular meeting should be held at Oxford, a place of manifold attractions for the large number of people engaged in varied activities at home and overseas who are participating in the gathering. Oxford, herself one of the older seats of learning, has never been guilty of an entire neglect of science for the arts. As long since as the year 1832, when the Association was in its second year, the meeting-place was Oxford, the invitation emanating from Charles Daubeny and William Buckland, who held between them the professorships of Chemistry, Mineralogy, Geology and Botany. Not all Oxford, however, welcomed the Association, and as the Prince of Wales reminded the distinguished gathering assembled to hear his presidential address, the proposal to confer honorary degrees upon men of the calibre of David Brewster, Robert Brown, John Dalton and Michael Faraday moved to anger the famous Keble, who stigmatised the scientific quartette as "a hodge-podge of philosophers." The next meeting of the Association at Oxford, held in 1860, was the occasion of the classical debate concerning the Darwinian theory of the origin of species between Bishop Wilberforce, Huxley and Hooker. The Oxford meeting of 1894 was marked by a discussion on flight, opened by Hiram Maxim, and ridiculed by Kelvin, and it was on that occasion that the first public demonstration of wireless signalling was given by Sir Oliver Lodge.

The present meeting finds the activities of the Association, as compared with the earlier gatherings, vastly extended. No fewer than thirteen sections are holding sessions concurrently day by day, and while in other areas in previous years there have been difficulties in housing these numerous sections, it has been found possible at Oxford to provide accommodation for most of them in the Museum Building, an arrangement which is much appreciated by those whose interests require attendance at different sections.

Presidential Address.

The Prince of Wales in his presidential address said that, at first sight, it might appear a hopeless task for one who knew nothing about science to talk to those who knew a great deal about science. To adopt a familiar saying, however, the onlooker could see a great deal of the game. For some years past, in war and peace, he had been privileged to have had countless opportunities of examining at close quarters the concrete results of applied science. The British

Association had always stood for co-operation between the scientific worker and the State, one of its principal aims being "to obtain more general attention for the objects of science and the removal of any disadvantages of a public kind which impede its progress."

The beginning of a new era was marked by the establishment of the National Physical Laboratory. It was at first set up in Kew Observatory, a building which, as a laboratory for magnetic and meteorological observations and for the standardising of instruments, owed its maintenance to the British Association for thirty years from 1841.

In historical sequence among the events which had strengthened interaction between science and the State there followed the establishment of the Development Commission in 1908. The creation of the Government Department of Scientific and Industrial Research was an act which fell, historically, within the period of the war; but as an outstanding incident in the scientific advancement of national affairs, it certainly was not to be regarded as merely a war measure. Nevertheless, by an odd freak of history, it needed the whole period of a century between one great war-time and the next—between the Napoleonic and the World Wars—to mature the conception of a State department of scientific research. Some idea of this kind was clearly present in the mind of Brewster, and certain of his contemporaries, concurrently with his idea of the foundation of the Association in 1831; and later—in 1850—when he addressed the Association from the chair, he claimed a strong advance in scientific and public opinion toward his views. Five years later a concrete proposal for the creation of a Board of Science, possessing "at once authority and knowledge" was put forward by the Parliamentary Committee of the British Association. It was not, however, entirely owing to lack of prevision on the side of successive Governments that the developments which had been outlined were so long delayed. There was an element of mutual distrust between science and the State—now, it might be believed, almost if not quite removed. A strong body of scientific opinion was avowedly afraid—as Sir George Airy phrased it—of "organisations of any kind dependent on the State." He hoped that modern developments had removed that fear. The progress of science could not be kept within training walls. The guidance of scientific research, in its inception, lay with the genius of the individual; its results for the future might be far beyond the realisation even of the scientific workers themselves.

A recent report of the Committee of the Privy Council for Scientific and Industrial Research showed that under the Department there were eleven research boards, some of which directed the work of committees to the number of three dozen in all. These boards co-ordinated and governed researches in chemistry, fabrics, engineering and physics, radio, building, food investigation, forest products, and fuel; and to them were to be added the Board of the Geological Survey and the Executive Committee of the National Physical Laboratory. Under the general supervision of the Advisory Council there were upwards of twenty industrial research associations formed in alliance with the same number of the principal industries of the country, for the purposes of scientific investigations connected with those industries.

The attitude of the State towards science made for an easing of the paths for the advancement of science in many directions; it marked a definite step in human progress. The movement for co-operation was not confined to Great Britain. It had borne fine fruit already in other lands; and in particular it was active in the British Dominions. The Indian Empire stood in a somewhat different category from these; there was here a tradition, for the application of science in its government, and the scientific results of its census investigations, its surveys, its agricultural, forestry, and other administrative departments had long been famous. This was not to imply that brilliant scientific work had been wanting in the Dominions. The trend of developments following upon all these movements had been similar, broadly speaking; it was sought to take a comprehensive survey of the natural resources and industrial opportunities of each Dominion, to explore the means by which science might be best applied to their exploitation; to provide, whether in State institutions or in university and other laboratories, for the pursuit of the necessary researches, to co-ordinate the work, and to ensure the dissemination of knowledge acquired.

The Empire was worth knowing. Travelling members of the Association had been able to see how science was cultivated in the universities of the Dominions and in many other institutions. Opportunities for travel were, however, none too common, but most people could at least cast their minds back to the Exhibition at Wembley. Science herself, as an exhibitor, took a place there befitting her natural modesty. The scientific exhibit arranged by the Royal Society, admirable as it was, was confined to two rooms of the Government Pavilion. But was not a very large proportion of the entire Exhibition, in point of fact, an exhibition of applied science?

It was not for a moment to be supposed, because the State had come to take a more active and practical interest in scientific research, that there was therefore any justification for the lessening of interest on the part of societies and individuals. It could never become the exclusive function of the State to aid the individual research worker. The State might, and did, co-operate in aiding him—as, for instance, through the universities and the Royal Society. Nevertheless, there were whole departments of research which did not come within the range of public assistance. Therefore, the support of science remained the concern of scientific societies, educational institutions, industrial organisations, and private benefactors, no less than it ever did; nay, the very fact that the State had lent its aid should encourage them to continue their aid and to reinforce it—indeed, there was satisfactory evidence that that actually happened.

But in order that the community might fully realise all that it owed, and all that it might owe, to the advancement of science, the channels of communication between research and the public mind had to be kept clear, maintained and widened. The non-scientific public was accustomed to view science as it might view a volcano; prepared for the eruption of some new discovery from time to time, but accepting the effects of the eruption without realising the processes which led up to it during the preceding period of quiescence. The period of preparation by research before science could offer the world some new benefit might be long, but the scientific machine was always running quietly in the laboratory. The public support of scientific research, upon all these grounds, should be accorded freely with understanding and with patience.

The Prince announced that a telegram of congratulation on his occupancy of the presidential chair had been received from the King, and that he proposed on behalf of the Association to send a reply expressing appreciation of the King's patronage and interest in the work.

SECTION B.

SCOPE OF ORGANIC CHEMISTRY.

Professor T. F. Thorpe, in his presidential address yesterday before Section B (Chemistry), dealt with the widening scope of organic chemistry. In his opening remarks he discussed the electrotonic theory, strainless systems, and bio-chemistry problems, and subsequently dealt with the utilisation of forest products and petroleum.

The complex hydrocarbons which formed the main constituents of crude petroleum belonged, he said, to a branch of organic chemistry which had been very little explored. It was true that many millions of profit had been made by the production and sale of petroleum products, but the percentage of that profit devoted to research in oil products had been infinitesimal. The reason was not far to seek. The apparently inexhaustible supplies of petroleum masked the necessity of devising means of economical working. It appeared that the conservation of the natural product was scarcely worth while. That observation applied not only to the methods used in fractionisation, but to the methods employed of cracking the higher boiling fractions into liquids of lower boiling point. At the present time it was the fraction up to 200 deg. Cent. yielding petrol which was the important product, but, owing to the rapid increase in the use of the motor vehicle for purposes of personal and commercial transport, it was clear that, at no distant period, the amount of the petrol fraction would be insufficient for the world's needs. That point indeed had been already reached in the United States, which required approximately 70 per cent. of the world's consumption of petrol. During 1925 the demand for petrol in that country was nearly 800,000,000 gallons a month, or about twelve times the quantity consumed in Great Britain.

Some interesting technical problems arose for consideration. The cracking processes at present in use did not produce aromatic hydrocarbons, and it was on the presence of a proportion of the aromatic hydrocarbons that certain special properties of petrol depended. The tendency was to produce for traction purposes internal combustion engines of high compression ratios with the object of diminishing the petrol consumption.

For reasons which research had not yet ascertained, the use of petrol which did not contain the requisite quantity of aromatic hydrocarbons of the benzene type was associated with detonation when ignited in cylinders giving more than a small compression ratio. Many devices had been suggested in order to overcome that difficulty, and a vast number of substances had been tried as anti-detonating materials. It had been found that one substance, namely, lead tetraethyl, possessed the property, when present in exceedingly small quantities, of preventing detonation of the explosion mixture. It was obvious, however, that the conditions which produced detonation, and why certain substances prevented it, required further and systematic research. The question was of greater importance for the reason that in high-compression engines of the type used in aeroplanes it was essential to use petrol containing a high percentage of aromatic compounds. In times of war those compounds would be required for the manufacture of explosives, and unless the whole problem of detonation were solved and another remedy provided, there would be a shortage of aromatic compounds.

It seemed probable that progress in the future would tend more and more towards the evolution of a motor car engine of the Diesel type, or one having a carburetter capable of vaporising the higher fractions of petroleum, and that, instead of having resort to cracking, a process by which the lower hydrocarbons could be converted into higher ones would be adopted. There were already methods by which that could be effected. Pure isoamylene could, for example, be converted into diamylene and the process could be carried to the point at which good lubricating oils could be obtained by the polymerisation of the lower unsaturated hydrocarbons. Polymerisation and depolymerisation were therefore the two operations which those engaged in the petrol industry must investigate and establish on a firm scientific basis if they were to be placed in a position to supply the public need in connection with any type of engine which the engineer might evolve. Especially was it desirable to ascertain under what conditions polymerisation led to the formation of aromatic and naphthenic hydrocarbons.

Considerable attention had been drawn during a recent period to the Bergius processes for depolymerising organic substances. The method had been used in the first instance for the treatment of coal, and it was known that the treatment brought about in organic substances fundamental changes, whether a catalyst were present or not, and that a wide field of research was opened up. It was doubtful, however, at the moment, whether general operations of that kind had been brought to the commercial stage. The plant required was exceedingly costly and the conditions subjected to wide variations which were difficult to control. Actually, it had been ascertained that, in the cracking of the kerosene fraction of petroleum, hydrogen was unnecessary and could be replaced by nitrogen. The occurrence of hydrocarbons of the naphthalene series in petroleum products had also been clearly established. The higher fractions which constituted the valuable lubricating oils also needed attention, as it was now certain that viscosity was unconnected with lubricating properties. The addition of small quantities of polar substances conferred increased oiliness on these compounds, but there was still a large field open to the research worker. The formation of free carbon occurred during both the distillation and cracking processes, and this carbon was utilised for the purpose of making electrodes. It was likely, too, that the formation of carbon in a condition in which it could be used by rubber tire manufacturers would be brought about. At present it had to be admitted that nothing was known about the structure of the hydrocarbons present in lubricating oils. It seemed possible that they might be polymerised products formed from unsaturated components likely to be produced or destroyed under comparatively mild conditions.

A point of some interest was the variation of the composition of petroleums coming from different sources. Some were rich in aromatic carbons, and some were practically sulphur free; others contained so much sulphur to render them unfit for use. The Kimmeridge shale oils were rich in sulphur and the oils from the Persian, Mexican, and Ohio fields contained sulphur, which had to be eliminated during the process of refinement, an operation which was now carried out on a very large scale at the Skewen refineries. It was gratifying to note that the Anglo-Persian Oil Company, recognising the need for research into the character of petroleum products, had established a research laboratory at Sunbury-on-Thames.

In conclusion, Professor Thorpe said that the experience of the war had made clear the relationship of the coal tar dye industry to the production of munitions, war gases, medicines, and other essential products. That knowledge would probably result in an effort by all the great industrial nations to retain dye industries of sufficient magnitude to meet peace requirements and to provide for war emergencies. Only by constructive research leading to reduced production costs could those industries maintain their competitive place in world trade.

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HEAVY GAP-BED ENGINE LATHE

SMITH, BARKER AND WILLSON, LTD., HALIFAX, ENGINEERS

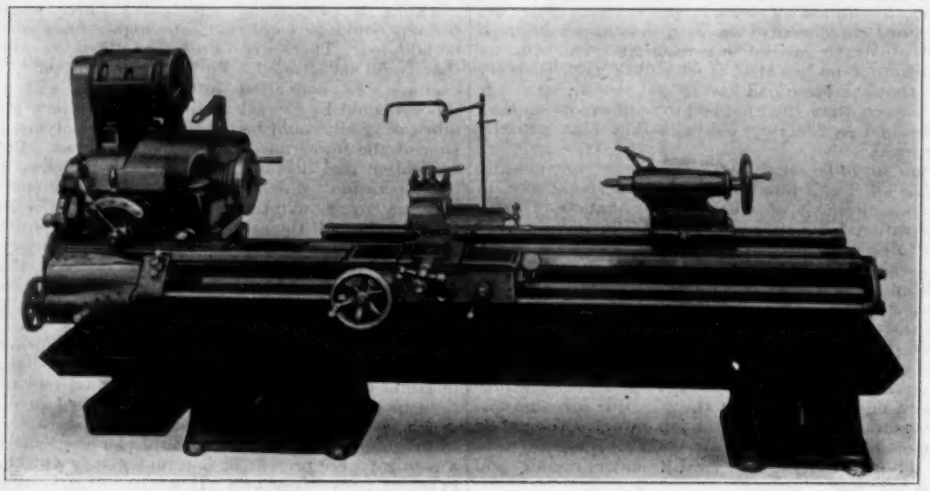


FIG. 1

Heavy Gap-Bed Engine Lathe.

ON a recent occasion we were afforded an opportunity of studying the construction of the 8½in. centres motor-driven gap-bed lathe illustrated herewith, and of hearing from the makers, Smith, Barker and Willson, Ltd., Halifax, the advantages which they claim for the interesting and unusual form of bed incorporated in its design. Mr. Willson criticises the ordinary form of gap-bed lathe on the grounds that much time is lost in removing and replacing the loose gap piece, that it is difficult to replace the gap piece accurately, and that when the gap piece is removed the end of the carriage next the headstock may be overhung and deprived of a portion of its support. It is not at all easy to see how these disadvantages can be overcome without abolishing the gap altogether. Yet Mr. Willson has succeeded in doing so without interfering with the normal characteristics of a gap-bed lathe. On the contrary, his design introduces consequential features which, judged by the rules laid down by Whitworth, must be regarded as steps towards improvement in the general arrangement of the lathe.

The elevation and diagrammatic cross-section—given in Figs. 2 and 4—together with the view of the headstock end—reproduced in Fig. 5—will serve to make the construction of the bed clear. The shears on the top of the bed are provided only for the support of the sliding tail-stock. They stop 13in. clear of the headstock. Beyond them the top of the bed casting is sunk down to form a gap with a concave bottom of sufficient radius to accommodate a 24in. face plate or work of an equivalent diameter. The carriage stands clear of the top shears, and is supported by a vee guide on the front of the bed and a flat guide on the back. These guides extend right up to the headstock, with the result that the carriage can overshoot the top shears while continuing to receive its full measure of support from the front and back guides.

The carriage at the front has extensions on both sides of the centre line of the tool post and is not supported as is usual in gap-bed lathes by a wing on the tailstock side only. The left-hand wing can slide past the face plate and remains fully supported in the most extreme position of the carriage. The elevation—Fig. 2—shows that with a 3in. piece between the centres the carriage has still a travel of 3in. open to it before any part of it touches the face plate, and that the tailstock, without an undue extension of the poppet, is still about 3in. short of overhanging the gap. The two wings have a total bearing of 25in. on the vee guide.

The cross-section—Fig. 4—shows that the back guide for the carriage is overshot by the rearmost tailstock shear,

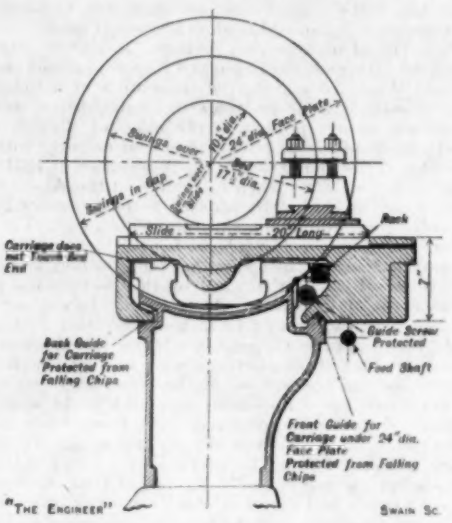

Face Plate 24"dia.
8" Carriage 9"
2½" dia.
Loose Head does not Overhang Gap
Gap 13" wide
Back
Carriage Bearing on Guide 12½" on L.H. of Centre of Bottom Slide
Carriage Bearing on Guide 12½" on R.H. of Centre of Bottom Slide
Carriage supported beyond 24" dia. Face Plate
1" Feed Shaft
Guide Screen Protected
Carriage Guide Protected
"THE ENGINEER"
SWAIN Sc.

FIG. 2—DIAGRAMMATIC SIDE VIEW OF GAP-BED LATHE

Carriage does not Touch Bed End
Slide
20" Long
Back
Back Guide for Carriage Protected from Falling Chips
Guide Screw Protected
Feed Shaft
Front Guide for Carriage under 24" dia. Face Plate Protected from Falling Chips
"THE ENGINEER"
SWAIN Sc.

FIG. 4—CROSS SECTION OF LATHE

and that the front guide is overshot by the rack. Both guides are therefore protected effectively from falling chips. It will also be noticed that the leading screw is placed between and inwards of the rack and the front guide. In this position not only is it protected from chips and accidental damage, but it is brought nearer than usual to the ideal position, namely, that in which the pull of the leading screw on the carriage is in the same vertical plane as the point of the cutting tool.

The machine is driven by a 4 horse-power motor mounted on the headstock and transmitting by belt and silent chain on to a pulley which runs at 250 revolutions. In Fig. 6 the interior arrangement of the headstock is shown. The driving wheel on the first shaft contains a friction clutch, which is expanded by the action of a taper-ended sliding key operated by a rack and pinion from a handle on top of the headstock cover. The sleeve on which the rack is formed is bored conically at one end to engage with a cone fixed to the casing and surrounding the shaft. Movement of the handle in one direction, therefore, engages the friction clutch and in the other stops the drive and applies a breaking effect. On the first shaft there is a group of three sliding gears, the individual members of which can be meshed separately with a triplet of wheels on the second shaft. Power is transmitted from the first or third wheel

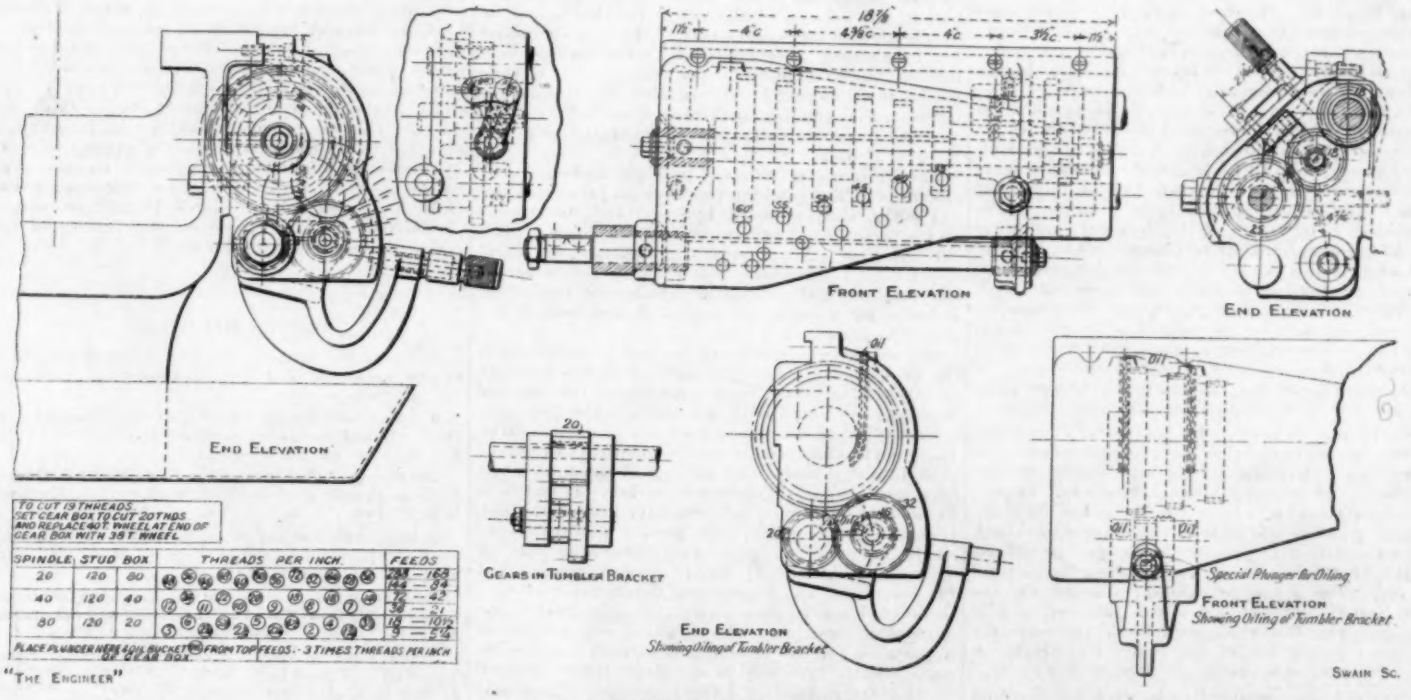

18⅞
FRONT ELEVATION
END ELEVATION
END ELEVATION
GEARS IN TUMBLER BRACKET
END ELEVATION
Showing Oiling of Tumbler Bracket
Special Plunger for Oiling
FRONT ELEVATION
Showing Oiling of Tumbler Bracket
TO CUT 19 THREADS SET GEAR BOX TO CUT 20 THDS. AND REPLACE 40T WHEEL AT END OF GEAR BOX WITH 38T WHEEL
SPINDLE | STUD BOX | THREADS PER INCH. | FEEDS
20 | 120 | 80 | 288 — 168, 144 — 84
40 | 120 | 40 | 72 — 42, 36 — 21
80 | 120 | 20 | 18 — 10½, 9 — 5¼
PLACE PLUNGER HERE & OIL BUCKET (80) FROM TOP FEEDS :- 3 TIMES THREADS PER INCH OF GEAR BOX
"THE ENGINEER"
SWAIN Sc.

FIG. 3—DETAILS OF FEED GEAR-BOX

of the triplet or from a pinion at the end of the second shaft on to the spindle, which, for the purpose, is provided with a sliding triplet. It may perhaps be worth noting that some economy of space and material is secured by applying the dog operating the three sliding wheels on the first shaft direct on to the largest of the three wheels and not, as usual, on to a race between two of them. The nine speeds obtainable from this arrangement of gearing extend from 9 to 250 revolutions per minute.

The feed-gear box—illustrated in Fig. 3—is of the such that no loose apron is required for the carriage, the shafts, wheels, &c., all having bearings in the carriage itself. The selection of the longitudinal or cross feed is controlled from a knob on the front of the carriage, which operates a single sliding gear wheel. This wheel can be set in a central position, in which condition all the feed transmitting wheels in the carriage are disengaged. Only when the spline shaft feeds are thus interrupted can the screw-cutting motion be engaged, for an interlocking lever beneath the carriage prevents the nut from being engaged

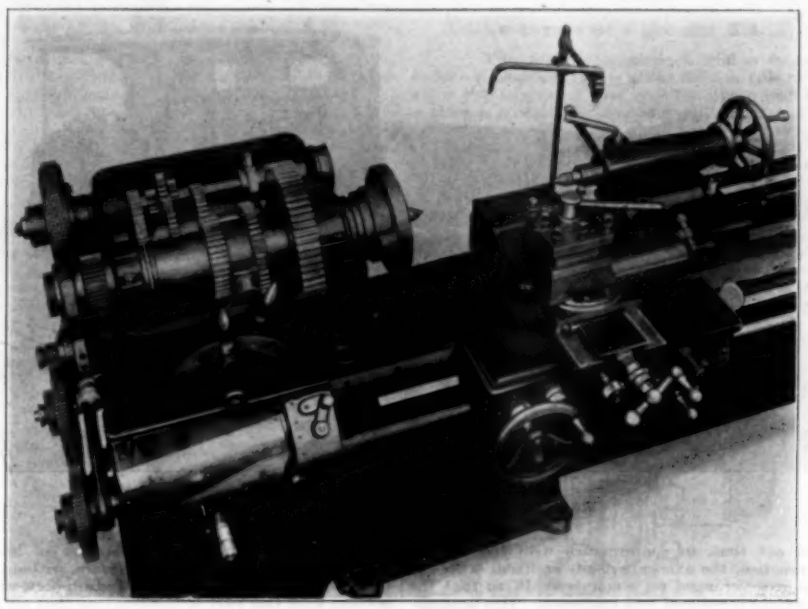


FIG. 5—HEADSTOCK WITH GEAR CASING REMOVED

"tumbler" pattern, and is driven by change wheels from the spindle. Five change wheels are provided, namely, one 20, two 40's, one 80 and one 120, and are used in three settings. With each setting the "tumbler" arrangement gives twelve different feeds, the six speeds obtained from the six wheels on the second shaft of the gear-box being multiplied by two by the provision of a second, double with the leading screw unless the sliding wheel is in the central position. Micrometer adjustments reading to thousandths of an inch are applied to the cross and longitudinal screws of the carriage. An indicating dial with a pinion engaging with the leading screw is attached to the side of the carriage to enable the screw-cutting feed to be re-engaged at the correct point on the leading screw.

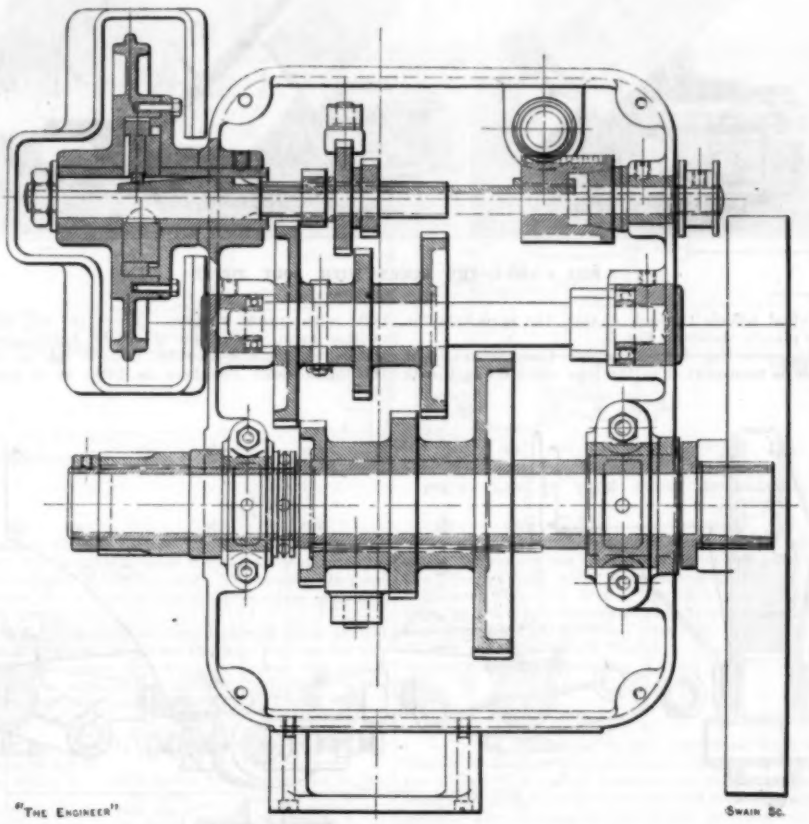


FIG. 6—INTERIOR ARRANGEMENT OF HEADSTOCK

sized, wheel on the tumbler bracket. From the second shaft of the gear-box the feed is transmitted through sliding gear wheels, either to the leading screw or the spline shaft. The change wheels and gear-box enable all common standard screw pitches, from 1¾ to 96 threads per inch, to be cut. To cut 19 threads per inch—a gas standard—an extra 38-tooth change wheel is required. When transmitted to the spline shaft the feeds obtained range from 5¼ to 288 cuts per inch. Attention has been paid to the oiling of the tumbler. A special oiling hole is provided for the tumbler plunger, and when the bracket is placed in the position defined by this hole two troughs in it are brought vertically below two oil pipes descending from the top of the gear-box casing.

The positions of the leading screw and spline shaft are

The tailstock can be set over for taper turning. It is clamped to the bed by an eccentric lock, and, in addition, when heavy cuts are being taken, by a bolt and nut fixing.

THE production by Ontario wells of 7,040,565,000 cubic feet of natural gas during 1925 is shown by the annual compilation of gas statistics issued by the Provincial Government. This production is valued at 3,888,397 dollars, which represents a decline of 187,607 dollars from the previous year. The figures show that 2155 wells, all situated in the western part of the Province, have been supplying natural gas for domestic use.

South African Engineering Notes.

Big Mining Amalgamation.

After protracted negotiations between the Cinderella Consolidated Gold Mines, Ltd., and the East Rand Proprietary Mines, Ltd., an agreement has now been arrived at. The Cinderella Mine will be taken over by its neighbour, and the two properties, worked as a joint concern, will become one of the biggest mining properties on the Witwatersrand. The E.R.P.M. is a low-grade mine, which crushes over 130,000 tons of ore monthly for a small profit, which rarely exceeds £10,000 and is often under £5000. The Cinderella has been idle for a number of years, as to enable it to be worked profitably as an independent concern it was found that another shaft would have to be sunk and the entire scheme of reorganisation would have required an enormous amount of fresh capital for expenditure on plant and machinery, which will now not be required, as the huge existing plant of the E.R.P.M. will suffice for both mines. This will mean that the working expenses will be greatly reduced on the E.R.P.M. portion of the property, while, as the mines adjoin, the ore in the Cinderella can be worked from the E.R.P.M.'s existing levels. During the short time the Cinderella worked it crushed 875,000 tons for a return of £1,224,000, equivalent to a revenue of 27s. 11d. per ton. Of the 2101 mining claims held by the Cinderella, only an insignificant portion has been opened up in the western section, leaving the great bulk of the area at present intact. The amalgamation will undoubtedly be of great benefit to the shareholders of both mines, while the reopening of the Cinderella will give employment to hundreds of Europeans and thousands of natives, and so benefit Johannesburg and the rest of the Witwatersrand.

Union Imports and Exports.

The total value of imports into the Union of South Africa during 1925 was £67,799,316, as against £65,894,781 in 1924; the value of the exports was £89,266,219, compared with £80,237,741 in 1924. The balance in favour of the Union was £21,466,903, compared with £14,342,960 in 1924. If the insurance, freight charges and gold premiums were taken into account, the credit balance would be reduced by £5,839,334. The percentage of imports from Britain was 49.3 against 49.0 in 1924. Britain supplied the Union with 67.4 of all textiles, including apparel, piece goods, yarn, &c. It also supplied 53.4 per cent. of all the imports of metals, metal manufactures, machinery, vehicles, &c.; 66.2 of all leather, rubber and manufactures thereof, including footwear. The total value of metals, metal manufactures, vehicles, &c., was £17,785,471. The United States of America is the greatest competitor in this class, with £4,519,090, with Germany next, £1,720,378. The increase in exports was largely due to the phenomenal crops of maize, which enabled over a million tons to be shipped, being an increase in value over the previous year of nearly 5½ million sterling, while diamonds were 1½ millions above 1924. The rapidity with which the use of motor cars is increasing in the Union is shown by the figures of imports for the last few years:—In 1923, 10,151 cars, valued at £1,721,183, were imported; in 1924, 15,476 cars, valued at £2,469,087; and in 1925, 18,396 cars, valued at £3,131,964. The increase appears to be likely to be as great as ever in 1926, for during the month of January, the only month in 1926 for which the exact figures are so far available, the number was 2499 cars, valued at £377,969, against 1196 cars, valued at £199,363, in January, 1925.

Mineral Output.

The total mineral output for the Union of South Africa in the month of May was valued at £4,794,992, compared with £4,553,920 in the corresponding month of last year. Diamonds were valued at £752,688, against £666,434; gold, £3,596,814, against £3,457,571; coal, £342,114, against £338,631; tin, £35,938, against £11,033; copper, £31,687, against £34,278; osmiridium, £6711, against £10,817. The total value of the mineral production for the first five months of 1926 was £22,966,551, against £22,480,886 in 1925. Diamonds were largely responsible for the increase, the value being £3,684,096, against £3,305,942 in 1925; gold was £17,151,405, against £17,009,974; copper, £212,321, against £210,607; tin, £137,414, against £97,918; and other minerals, £116,249, compared with £108,667. Coal decreased somewhat, the value being £1,569,210, compared with £1,620,452 for the same period of last year. The quantity of osmiridium recovered has also fallen, the value being £41,395, against £55,981 in 1925. Up to the end of May 1052 oz. of crude platinum had been produced, but no value can be given pending the refining in England and subsequent sale.

Industrial Expansion.

In pursuance of its intention to increase the steel production at its Vereeniging Steel Works to 50,000 tons per annum, so as to utilise the whole of the pig iron from the Newcastle blast-furnace, which was recently blown in, the Union Steel Corporation, Ltd. (South Africa), is erecting at Vereeniging a rod mill, wire works and galvanising works, for reinforced concrete work, special steel rods for the existing steel rope works at Johannesburg, and for the nut and bolt work which was erected at Vereeniging in November last. The capacity of the wire-drawing plant will be 10,000 tons per annum. The Union Mining Machinery Company also proposes to erect a works at Vereeniging for the manufacture of steel tubes and cast iron pipes. The new customs tariff rates are inducing people to erect factories for the manufacture of clothing and shirt-making, also printing and bookbinding, boot and shoe and furniture factories, and also tanneries, while large extensions are being made to factories already existing. Among the most important developments now taking place, or seriously contemplated, are the following:—A new factory is being established at Johannesburg by the Briquette and Patent Fuel Manufacturers of Africa, Ltd. The factory will have an output of 400 tons of briquettes and patent fuel per day. The Cape Explosives, Ltd., is making extensions at its factory at Somerset West to bring the capacity of

its superphosphates plant up to 60,000 tons from 42,000 tons per annum at the end of 1926. Considerable extensions to the plant of the Talana Glass Works, Natal, have been made. New plant to the value of £20,000 has been ordered, and is now on the way. Three glass experts have been brought out by the company. A new factory is to be established in Cape Town for the manufacture of hosiery; while a prominent English firm proposes to establish a factory for the manufacture of cotton blankets. Plans for a new factory for the Port Elizabeth Boot Company have been passed. A proposal is on foot for the establishment of a vegetable tinning factory at Durban, for a fishmeal factory at Capetown, and a new factory for the South African Chemical Products, Ltd.; while extensions in the hat and cap manufacturing industry are probable, judging from inquiries received from well-known firms in England and America. The establishment of two factories for expressing oil from castor beans, ground nuts, cotton seed and fruit kernals is having favourable consideration. Representatives of oversea firms are now in this country in connection with the establishment of a shark-leather manufacturing industry. The Tulbach Municipal Council has decided upon an electric lighting and power scheme for the town, and plans have been drawn up for it. Several other municipalities have previously been mentioned as having decided upon installing electrical plant, &c. In addition to the schemes mentioned above there are many smaller enterprises being undertaken, and numerous extensions of factories, so that the demand for machinery and plant of various descriptions will be very large for this year and into the beginning of next.

Walvis Bay Development.

Walvis Bay, which is the only large and safe harbour along the whole of the coast of South-West Africa, is to be further developed by the South African Railways and Harbours Board. Lay-out plans have been prepared and it is understood that about October or November next it will be possible to berth a passenger steamer at one of the new wharves. There are three jetties at Walvis Bay harbour, which are 480ft., 190ft., and 675ft. long respectively. No. 1 jetty has two 3-ton cranes, and No. 3 one 2-ton crane, in addition to the 10-ton breakdown crane which is always available. No. 2 jetty is used for cattle. A wharf is in course of construction on concrete piles and beams; it will have a wide deck and be 1000ft. long, with 33ft. depth L.W.O.S.T. Cranes will be required for this wharf. The harbour is equipped with shed and storage accommodation, about fourteen lighters and two tugs, and several wooden "floats." There is also a new slipway under consideration for executing repairs. At present there is a large whaling station at Walvis Bay and sealing is carried on at Cape Cross. The Sandwich Islands, off the coast, also provide an extensive business in connection with guano. The Railway Administration Board intends to build a new railway station, and a temporary station will also be erected inside the railway reserve, for the use of passengers from steamers.

A Six-wheel Steam Lorry.

With the object of providing a commercial vehicle which would carry loads of 12 tons or so and avoid the difficulties in manœuvring which are common to some forms of articulated six-wheeled lorries, while retaining the advantage of being allowed to travel over the roads at 12 miles per hour, Richard Garrett and Sons, of Leiston, have recently brought out a form of wagon which has six wheels all arranged under one rigid frame. The machine is a development of the steam lorry which we described and illustrated in our issue of April 7th, 1922, and in so far as the engine, transmission gear, front axle, &c., are concerned, the new wagon is just the same. The chassis has, however, been considerably lengthened to accommodate the two driving axles, and, like all of the other Garrett steamers, the new six-wheeler is fitted with the cross-tube boiler mentioned in our previous notice. In this boiler all the tubes are easily accessible through a large rectangular door bolted on to the front of the shell and firing is effected through a shoot at the footplate level.

The general appearance of the new lorry is well illustrated by our half-tone engravings, which, incidentally, show how the body is tipped by means of a hydraulic ram. These views also show how the two driving axles are arranged quite close together in order to reduce the fixed wheel base as much as is possible.

The arrangement of the back axles is best shown in the line drawings Figs. 4 and 5, and first and foremost it should be pointed out that, in conformance with the Garrett standard practice, the axles are dead, or fixed, with the differential gear arranged on a countershaft, so that the unsprung weight is reduced to a minimum. This arrangement naturally involves the transmission of the drive to the individual wheels through chains, the sprockets for which are plainly shown in Fig. 5.

On reference to Fig. 4 it will be seen that the weight of the vehicle is transmitted to the rear axles on each side through an inverted semi-elliptic spring, which rests at its ends on pads keyed to the axles and is embraced at the centre by a substantial stirrup that is pivoted at the bottom to what might be described as a pair of horn plates fixed to the sides of the main chassis member. The pivot, it will be noticed, is provided with a longitudinal screw adjustment, so that the whole assembly can be moved fore and aft for the adjustment of the tension on the main driving chains. It will be evident from an inspection of this view that the stirrup, and with it the spring, can rotate about the pivot pin through a considerable angle, in order to accommodate unevenness in the road surface, and, as a fact, two axles can have a difference of level of 1ft., taking the line of the chassis as datum, without any of the parts fouling one another. It is also noteworthy in connection with this part of the machine that all the attachments to the side frames are made by means of machined bolts with spring washers. There are no riveted joints of this form, while the necessary holes are drilled in the webs instead of the flanges, so as to weaken the main frame members as little as is possible.

The plan view, Fig. 5, is chiefly interesting in that it shows the arrangement of the brakes, but it also indicates the two distance bars which fix the centre distance of the driving axles. It will be noticed that they are provided with screw adjustments to take up the stretch of the two chains, that connect the two pairs of driving wheels, and that they have spherical seatings at the ends to accom-

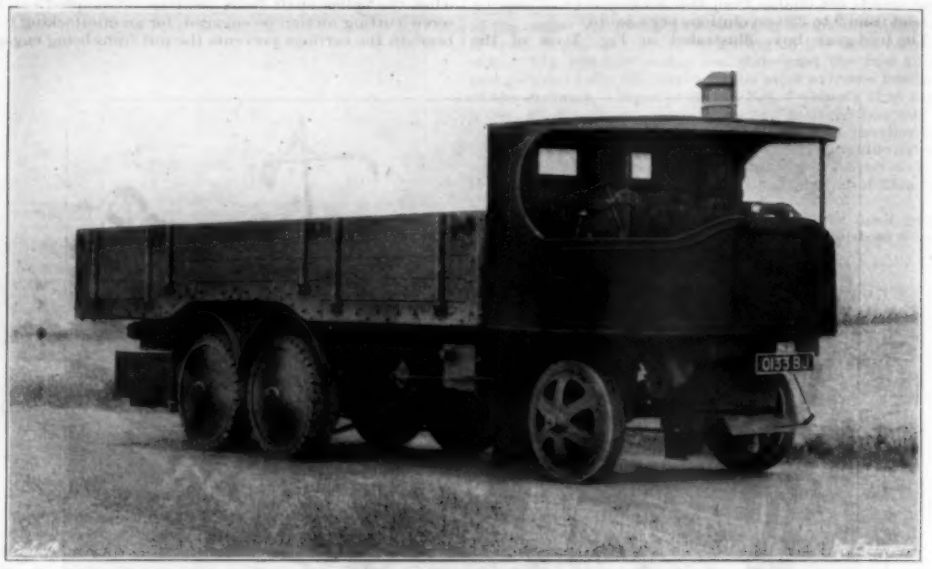
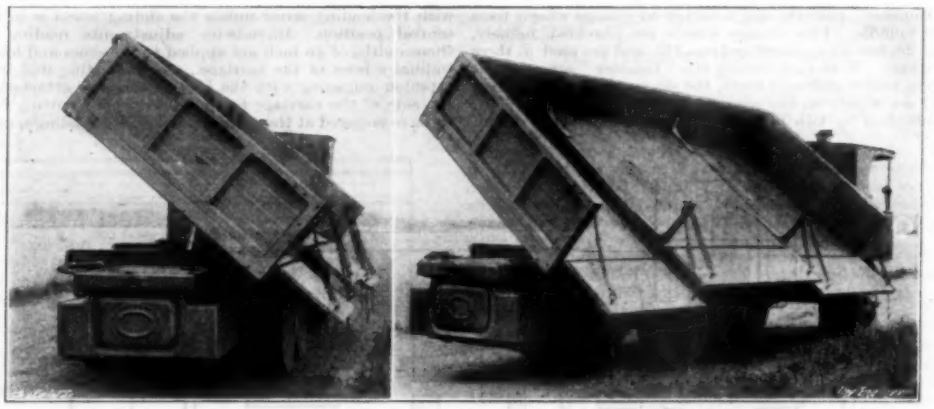


FIG. 1—GARRETT SIX-WHEEL 12-TON LORRY



FIGS. 2 AND 3—THE LORRY WITH BODY TIPPED

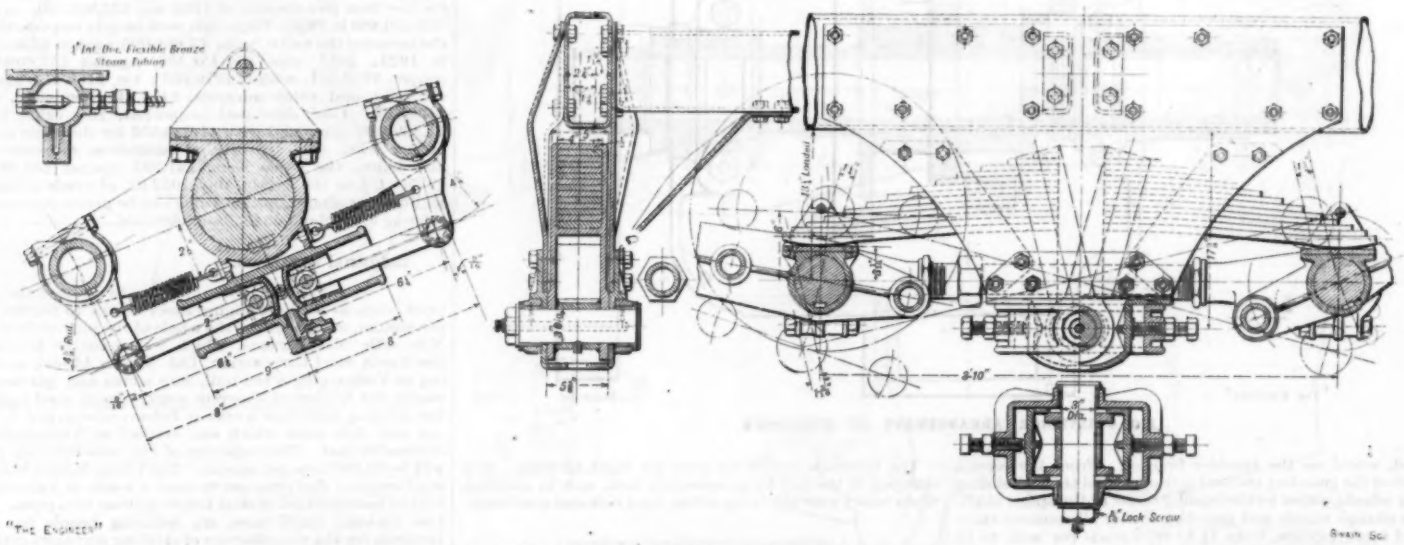


FIG. 4.—ARRANGEMENT OF SPRINGS AND STEAM BRAKE

modate the relative movement of the axles on bumpy roads.

Each of the driving wheels is furnished with a drum to accommodate a pair of internal expanding brakes. That is to say, there are eight brakes in all. On the front driving axle one pair of brakes, one brake on either side, is controlled by a foot pedal, in the same way as is common in motor cars, while the other pair is operated by a side lever. The arrangements made to balance the pull on the units of each pair of brakes are so obvious in the drawing as to need no comment; but it is noteworthy that the brake shoes are carried by extensions of the operating shafts which are journalled in the main radius rods. The makers say that they find from experience that that is the most satisfactory means of ensuring concentricity between the shoes and the drums, regardless of wear, and that there is no liability for the brake shoes to drag on the drums and get heated through wear.

The pair of brakes on the back axle is operated by steam and is only employed occasionally, as, for instance, in descending a long hill which might overheat the other brakes if used alone. As a matter of fact, the foot brake is sufficient for all ordinary driving purposes. The steam brake—see Fig. 4—is a very simple affair and comprises a little cylinder 2in. in bore, in which there work two pistons connected with the two brake shafts. The cylinder can be supplied with steam from a valve in the driver's cab through a length of flexible metallic piping, and so soon as steam is admitted the ball valve, which can be seen below the cylinder, closes, so that the full boiler pressure can be employed to force the pistons apart and apply the brakes. When the steam is turned off again the slight drop of pressure in the cylinder due to condensation and the weight of the ball itself cause the ball to drop into the open position shown in the drawing. The brakes are then released under the action of the coiled springs attached to the shaft levers.

Apart from the features described above, the new vehicle is the same in general design as the four-wheeler we described about four years ago, with, of course, the added exception that its capacity is materially increased, as is shown by the following leading particulars:—

	Non-tipper.	Side-tipper.
Net load capacity ..	12 tons ..	12 tons
Inside dimensions of standard body ..	22ft. by 6ft. 9½in. by 18in. ..	19ft. 6in. by 7ft. by 2ft. 2in.
Overall length	28ft. 6in.	26ft. 6in.
Overall width	7ft. 3½in.	7ft. 3½in.
Overall height	9ft. ..	9ft.
First wheel base ..	13ft. 4in. ..	11ft. 4in.
Second wheel base ..	3ft. 10in. ..	3ft. 10in.
Turning circle	55ft. ..	52ft.
Load line, light	3ft. 10½in. approx.	4ft. 2in. approx.
Load line, loaded ..	3ft. 8½in. approx.	4ft. approx.
Road speed	12 m.p.h. ..	12 m.p.h.
Gear ratio (crank shaft to road wheels)—		
High		1 : 4·88
Low		1 : 12·55

It might be urged by some people that the steering of a road vehicle which has a fixed wheel base, even of only 3ft. 10in., would be laborious for the driver, but we are assured that it is not so, probably on account of the accommodating nature of the rubber tires, while the convenience in backing or manœuvring the rigid six-wheeler, in comparison with an articulated wagon, needs no emphasis. As regards the ability of the machine to accommodate itself to rough ground, it is noteworthy that during some recent trials one of these wagons was driven freely across country loaded up with 14 tons without any difficulty or damage to the mechanism.

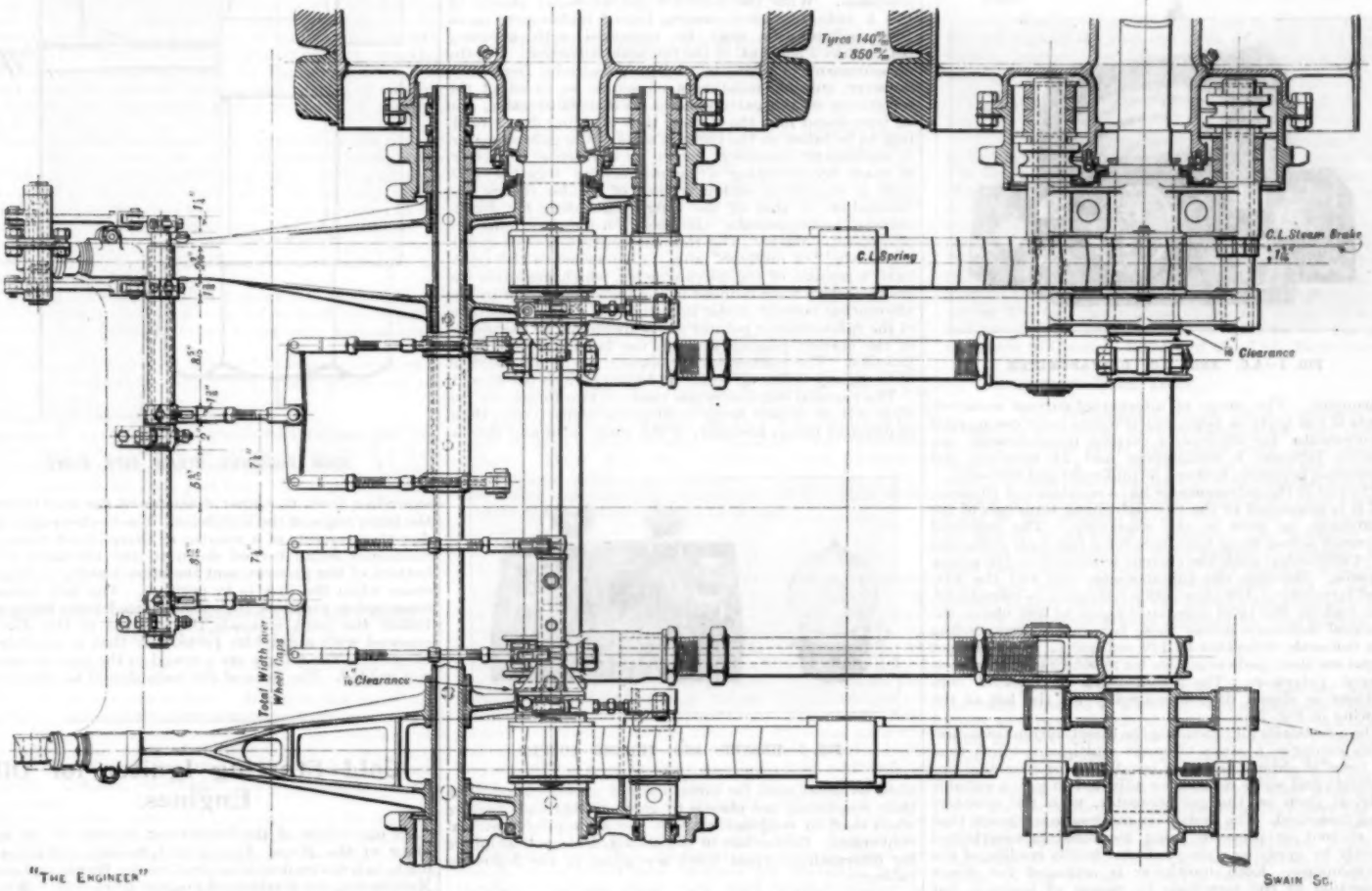


FIG. 5—PLAN OF BACK AXLES OF 12-TON LORRY

American Engineering News.

Uniflow Engines for a Blooming Mill.

THE first application of uniflow engines to an American blooming mill is at the Steubenville rolling mills, where two engines of that type have been installed. One of them is a reversing blooming mill engine and the other a continuous mill engine, while the other has a fly-wheel and its cut-off is controlled by a governor with hydraulic thrust cylinders. Each engine has four cylinders, 36in. diameter and 60in. stroke, taking steam at 240 lb. pressure at the stop valve and 125 deg. Fah. superheat. The reversing engine at 150 revolutions and maximum cut-off will deliver 30,000 indicated horse-power momentarily, the engine being reversed about twenty times per minute. The continuous mill engine at 75 revolutions and 45 per cent. cut-off will develop 14,000 indicated horse-power. The engines use, respectively, 16.3 lb. and 10.5 lb. of steam per indicated horse-power hour. For the reversing engine the normal capacity is 200 tons of steel per hour, at a steam consumption of some 300 lb. per ton of steel. These are the largest and most powerful engines of the type yet built, although a rolling mill engine has larger cylinders, 60in. by 66in. The five main bearings are 22in. by 28in. and the crank pins 21in. by 16in., while the hollow piston-rods are 10in. diameter. The 20ft. fly-wheel on the continuous mill engine weighs 37 tons and each engine complete represents a total weight of about 500 tons.

Steel Mill Practice.

At a meeting of the American Iron and Steel Electrical Engineers a discussion as to the cost of power per ton of steel rolled brought out the fact that there is very little difference between the cost for steam and electric power. The deciding factors in any one case would be the initial investment and the costs of steam and electric current in that particular locality. With the 30,000 horse-power uniflow engine at the Steubenville mill the steam rate is about 300 lb. of steam per ton of steel rolled, the rolling capacity is nearly 200 tons per hour, and the investment cost was nearly £150,000 less than would have been required for an electric installation. A committee of this Association is co-operating with manufacturers of mill type electric motors in an endeavour to produce standardised designs, thus reducing the maintenance costs and the stock of spare equipment. Another investigation is with regard to more economic operation of gas producer plants by the wider use of recording instruments as a guide for the operators and to check the usual excessive variations. Such an improvement would result in a better and more uniform quality of gas. On the subject of refractories it was the opinion that no great improvement in quality can be expected, but that the life may be prolonged by changes in furnace design and operation and the use of water-cooling and suspended arches.

Heavy Excavation for Open Mining.

In the open mine operations of the United Verde copper mine in Arizona electrically-operated navvies or excavators are employed extensively. This method of mining was adopted to recover large bodies of ore which have been abandoned in the upper levels on account of extensive fires. It is proposed to remove the entire ore body in this way to the 300ft. level, but the present programme is to clear it to the 160ft. level by the middle of 1927. Up to the end of 1925 there had been excavated 5,787,000 cubic yards of stripping or overburden and 808,000 cubic yards of ore, leaving 1,222,000 yards of overburden and 190,000 yards of ore above, the 160ft. level. Steam excavators loading large side-tipping railway wagons are used in part of this work. Below this level the ore is being excavated in benches and loaded into motor trucks which dump into shafts or raises extending to the 1000ft. level. Each electric excavator with its 1¼-yard bucket is served by three trucks of 2 cubic yards capacity, the ore ranging in weight from 3½ to 5 tons per yard. The average lead or haul is about 600ft. Power consumption by the excavators averages 1.3 kilowatt-hour per cubic yard handled, including night lighting. The excavators work two shifts per day, 7.30 a.m. to 5 p.m. and 6 p.m. to 2 a.m. About 3½ million cubic yards of material remain to be excavated down to the 500ft. level, working in benches of 25ft. to 30ft. in height. Old timbers in the abandoned workings are troublesome, and are pulled out with a tractor crane. Sulphurous gases from burning ground is another trouble, sometimes necessitating the use of gas masks by the excavator men and others.

New Water-tube Locomotive Boiler.

In the McClellon boiler as applied to a locomotive on the New York, New Haven and Hartford Railroad, the fire-box consists of slightly inclined rows of tubes forming the sides and connected to two small bottom drums at the foundation ring and to two longitudinal larger drums at the top, 23in. in diameter. Between these is a third drum 31in. diameter, all drums being 15ft. long. At the forward end is the tube plate of the boiler, while the back head is formed by a similar row of transverse tubes, the middle ones being connected to a horizontal header above the fire-door. The working pressure is 250 lb. The engine is of the 4–8–2 type, for heavy goods traffic, and is a three-cylinder compound with all cylinders 22in. by 30in. Its total weight is 180 gross tons, with 125 tons on the drivers. As compared with similar engines of ordinary construction, a saving of 10 per cent. of coal has been obtained, all engines working the same traffic. In all these three-cylinder engines the middle cylinder is inclined, and the first driving axle is spaced further from the second axle, so that the inside connecting-rod does not necessitate a bent axle for the leading drivers. The outside cylinders drive the third axle. The driving wheel are 5ft. 9in. in diameter. In the engine that has a water-tube boiler the cut-off is limited to 70 per cent. of the stroke and in service the engine works with a shorter cut-off than the other engines.

A Galvanometer for Direct and Alternating Current Measurements.

A SIMPLE form of galvanometer brought to our notice by the Cambridge Instrument Company, Ltd., of 45, Grosvenor-place, S.W. 1, has been designed to cover a wide range of measurements of current or voltage on direct or alternating-current circuits. The instrument has a large field of usefulness in connection with general testing and experimental work in laboratories, workshops and power stations, and is of value to all who are connected with the measurement of alternating or direct currents of ordinary commercial magnitude.

The galvanometer, which is shown in Fig. 1, is of the moving coil unipivot type, in which the coil is pivoted upon a single point at its centre of gravity. Its sensitivity renders it available for use in connection with measurements involving a high degree of accuracy, and it also presents the advantage of portability and robust construction. It is provided with two scales approximately 110 mm. long—a millivolt scale with a range of 0-120 for direct-current measurements, and a thermal scale of the same range for alternating-current work.

The instrument has four terminals, and by making use of interchangeable accessories, which can easily be attached to these terminals, the instrument can be made to measure a wide range of direct or alternating currents and pressures. Measurements of direct currents as small as 2 microampères or as large as 24 ampères can easily be made, whilst direct-current pressures ranging from 20 microvolts up to 600 volts are also within the range of the

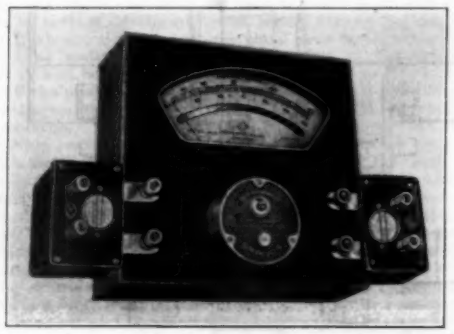


FIG. 1—A.C. AND D.C. GALVANOMETER

instrument. The range of alternating-current measurements is not quite so large, but it meets most commercial requirements, for alternating-current measurements are possible between 1 milliampère and 24 ampères and alternating pressures between 30 millivolts and 600 volts.

The coil of the galvanometer has a resistance of 10 ohms, and it is connected to the two right-hand terminals of the instrument, as seen in the engraving. The potential difference across these terminals for a full-scale deflection is 2·4 millivolts, while the current sensitivity is 240 microampères. Between the galvanometer coil and the left-hand terminals a 490 ohm series resistance is introduced, thus making the total resistance equal to 500 ohms, the potential difference across these terminals corresponding to a full-scale deflection of 120 millivolts. Two distinct ranges are thus made available for measuring small direct-current potentials. The arrangement of internal connections is shown diagrammatically on the left of the drawing in Fig. 2.

The accessories for extending the direct-current measurements comprise a series of range multipliers which take the form of shunts or series resistances or combinations of shunts and series resistances adjusted to give a suitable millivolt drop on the galvanometer, with the quantity being measured. The multiplier ranges are so chosen that the current or pressure being measured is ascertained directly by applying a simple factor to the reading of the galvanometer. Each multiplier is arranged for direct connection to the terminals by means of tongues, but tapered holes enable connections to be made at any distance by plug-ended leads. The multipliers are made in the form of interchangeable units for either volts or ampères and cover ranges up to 600 volts or up to 24 ampères. The following tables give the data for standard direct-current multipliers, but it is clear that by using different resistances the range could be extended indefinitely.

D.C. volt range multipliers.			D.C. ampère range multipliers.		
Volts for full scale deflection.	Scale factor, volts per division.	Circuit resistance,* ohms.	Amps. for ful scale deflection.	Scale factor, amps. per division.	Circuit resistance,* ohms.
0·24	0·002	1,000	0·012	0·0001	10
0·6	0·005	2,500	0·06	0·0005	2
1·2	0·01	5,000	0·12	0·001	1
2·4	0·02	5,000	0·24	0·002	0·5
6	0·05	5,000	0·6	0·005	0·2
12	0·1	5,000	1·2	0·01	0·01
24	0·2	5,000	2·4	0·02	0·05
60	0·5	5,000	6	0·05	0·02
120	1	10,000	12	0·1	0·01
240	2	10,000	24	0·2	0·005
480	4	20,000	—	—	—
600	5	30,000	—	—	—

* Between terminals of range multipliers when connected to galvanometer.

For alternating-current measurements it is necessary to use a thermal accessory with the galvanometer and the standard accessory for that purpose is a vacuo junction, consisting of a heater composed of a fine wire, to the centre of which a small thermo-couple is attached. When alternating current is passed through the heater the temperature of the thermo-couple is raised, thus causing a small direct current to flow in the thermo-couple circuit. The heater and thermo-couple are enclosed in a highly exhausted bulb, about 25 mm. in diameter, as shown in Fig. 3.

When measuring radio frequency currents it is essential that no appreciable inductance or capacity should be introduced into the circuit. On account of the presence in the vacuo-junction of the short, straight wire forming the heater these conditions are fully met, and this feature, combined with its extreme sensitivity possibly makes the vacuo junction the only convenient arrangement for accurately measuring the small currents used in radio frequency work. It is also essential when measuring currents of high frequency that no resistances, however non-inductive, should be introduced into the circuit.

When it is desired to measure a wide range of currents,

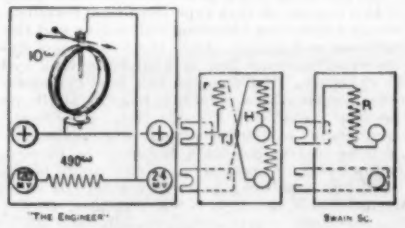


FIG. 2—INTERNAL CONNECTIONS OF GALVANOMETER

therefore, it is usual to employ a number of separate vacuo-junctions. With the unipivot galvanometer shown in Fig. 1 radio frequency ranging from 1 milliampère up to 1000 milliampères may be measured with accuracy better than 2 per cent. of the full-scale deflection. For the measurement of currents of less than radio frequency, however, suitable resistances, chosen so as to adapt the sensitivity of the galvanometer to a definite value, can be introduced into the circuit, thus enabling direct readings to be taken on the thermal scale of the galvanometer. A convenient accessory, known as a thermal converter, is made by mounting a vacuo-junction, together with such a resistance, within a case of similar design and dimensions to that of the range multipliers for direct-current measurements, the case forming an effective electrostatic shield. The thermal converter, corresponding to the 2·4 millivolt range, is connected to the right-hand terminals of the galvanometer, which measures the electromotive force induced in the thermo junction by the alternating current under investigation. The deflections of the galvanometer pointer are proportional to the square of the current passing through the heater in the vacuo-junction. The converters are claimed to be independent of frequency errors up to about 10,000 periods per second.

The thermal converters are made in two forms, for use with volt or ampère range multipliers respectively, these multipliers being, however, of the same form and dimen-

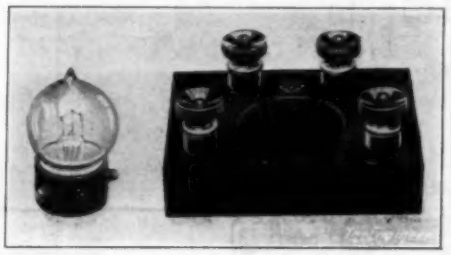


FIG. 3—HEATER AND THERMO-COUPLE

sions as those used for direct-current measurements, but their resistances are chosen to give suitable scale factors when used in conjunction with the appropriate thermal converters. Particulars of the standard range multipliers for alternating-current work are given in the following table :—

A.C. volt range multipliers.			A.C. ampère range multipliers.		
Volts for full scale deflection.	Scale factor, volts per division.	Circuit resistance,† ohms.	Amps. for full scale deflection.	Scale factor, amps. per division.	Circuit resistance,† ohms.
0·36*	0·003*	10*	0·18*	0·0015*	1*
0·6	0·005	16·67	0·6	0·005	0·3
1·2	0·01	33·33	1·2	0·01	0·15
6	0·05	166·7	6	0·05	0·03
12	0·1	333·3	12	0·1	0·015
60	0·5	1,667	24	0·2	0·0075
120	1	3,333	—	—	—
240‡	2	6,667	—	—	—
480‡	4	13,333	—	—	—
600‡	5	16,667	—	—	—

* Thermal converter alone, without multiplier.

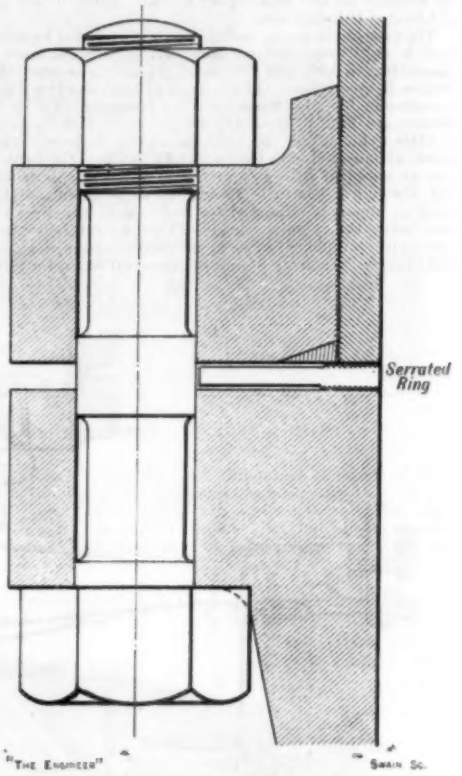
† Between terminals of range multiplier when connected to galvanometer.

‡ These multipliers are provided with flexible leads and connections.

A thermal converter is shown attached to the right-hand terminals of the galvanometer in Fig. 1, whilst a range multiplier is connected to the left-hand terminals. The illustration, Fig. 2, shows diagrammatically the arrangement of the galvanometer and accessories as used for alternating current measurements. The thermal converter is to be seen in the centre of the diagram. The thermal junction T J is connected in series with a small resistance r connected across the tongues, while the heater H, together with a small shunt and series resistance, is connected between the terminals of the converter. The alternating current multiplier shown on the right of the diagram contains a high series resistance R for reducing the pressure at the converter terminals.

High-pressure Pipe Joints at Langerbrugge.

IN response to inquiries we are glad to be able, through the courtesy of Babcock and Wilcox, Ltd., to give the following particulars of the steam pipes at Langerbrugge power station, fully described in our issue of June 4th last. All joints in the high-pressure steam pipe line (800 lb.) are made as follows :—The pipe flanges are faced off flat and square. Between them is inserted a disc of mild steel, machined all over, bored to the pipe diameter and turned to such a diameter that it touches the flange bolts. On each of its faces is a series of V-shaped concentric grooves

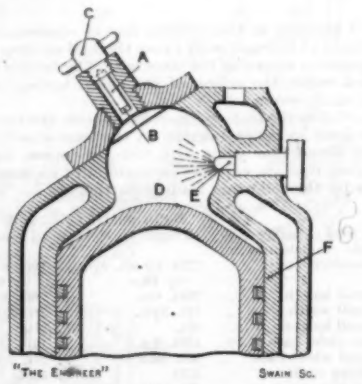


HIGH-PRESSURE STEAM PIPE JOINT

extending from the inner diameter of the disc to nearly the inner edges of the bolt holes. The working face of the disc thus consists of a number of sharp-edged ridges, the remainder being turned down to the thickness at the bottom of the grooves, and therefore leaving a clearance space when the disc is in position. The bolt holes are reamered in position, turned and fitted bolts being used. Before the joint is made the grooves of the disc are smeared with a graphite paste, but that is possibly not essential. The flanges are screwed to the pipe, expanded, and welded. The form of the bolts should be observed.

Cold-Starting Igniter for Oil Engines.

IN our notice of the Implement Section of the recent Show of the Royal Agricultural Society, reference was made to a device developed by Crossley Brothers, Limited, Manchester, for starting oil engines from cold. We refer to the self-lighting igniter. During the last few years



THE CROSSLEY COLD-STARTING IGNITER

several firms have supplied engines with which is used a combustible cartridge, consisting of chemically treated paper or other material, which is first lit with a match and then placed in an aperture in the engine cylinder, where it glows and forms an igniter for the fuel charges while the engine is being started and being run up to speed, by which time the combustible material is consumed. The subsequent ignitions are effected in the usual manner, *i.e.*, by the heat of compression and of the combustion chamber walls.

Messrs. Crossley's new igniter goes a step further than

the afore-mentioned cartridge, as it ignites spontaneously by the heat of compression, no naked light being necessary, and the engine can be started in a strong wind or rainstorm. This igniter can be made in several ways. One method is to use a combustible wad impregnated with saltpetre—as shown at A in the accompanying illustration—which represents the cylinder head of a two-stroke oil engine. On the end of the cartridge is the ignition material B. The cartridge is held in a plug C screwed into the cylinder cover. When the engine is started—even by hand and with reduced compression—the ignition material ignites by the heat generated, and in turn lights the cartridge A, which continues to glow and set fire to the fuel charges injected into the combustion chamber D through the oil-sprayer E, until the "burner" is consumed, by which time the temperature in the cylinder head is sufficient to effect the subsequent ignitions of the fuel. By means of this invention, for which patents have been applied for, oil engines of the direct injection type can be readily started without preheating. Small engines up to 25 horse-power can be started by hand, and larger engines by compressed air at low pressure. We saw an engine started on several occasions from cold during the Reading Show, both by hand and by compressed air with reduced compression, and we are informed that during the period of the Show this engine was started up more than eighty times under similar conditions without failure.

ASBESTINE, ZINC OXIDE AND VARNISHES.

THE British Engineering Standards Association has just issued British Standard Specifications for zinc oxide (types 1 and 2) for paints, asbestine for paints, interior oil varnish, exterior oil varnish and flatting or rubbing oil varnish. They contain clauses regulating the composition, together with standard reception tests, for the purchase of zinc oxide, asbestine, interior, exterior and flatting or rubbing oil varnish and appendices giving methods of carrying out the tests.

These specifications have been prepared at the request of the paint manufacturers by a Committee representative of both the buying and manufacturing interests, and, as in the case of all British standard specifications, they will be reviewed as experience of their working or progress in the industry renders it necessary, and revised issues will be published from time to time. Amongst other specifications in hand which will be published as completed are the following :—

Painting materials—Boiled linseed oil, zinc oxide oil paste, barytes, red oxides of iron, red oxide of iron oil paste, lead chromes, Prussian blues, lithophone, carbon black and gold size.

Ready mixed linseed oil paints—White lead, tinted white lead, zinc oxide, tinted zinc oxide, black, green and red oxide of iron.

Extra hard drying oil varnish.

Copies of these five new specifications (Nos. 254, 255, 256, 257 and 258, 1926) can be obtained from the B.E.S.A., Publications Department, 28, Victoria-street, London, S.W. 1, price 1s. 2d. each post free. Amongst the specifications that have already been issued are those for genuine dry white lead (No. 239), 1926, and genuine white lead oil paste (No. 241, 1926).

TELEPHONE AND TELEGRAPH DEVELOPMENTS IN ITALY.

THE Milan newspaper has recently published details of the extensive plans for the development of the telephone and telegraph systems in Italy. It states that many new underground telephone lines are to be laid by means of which long-distance conversations will be possible, not only between all parts of the country, including Sicily, but also with Switzerland, the north of France, England, Belgium, Holland, Germany, Czechoslovakia, Austria and Poland.

Plans have been drawn up in accordance with the most modern technical systems. It is intended that the capacity of the various lines shall be adequate to meet the heaviest demands made upon them, and that part of the system shall also be available for telegraphic service. The first group of lines has, it reports, been entrusted to the Società Italiana Reti Telefoniche Internazionale, which is already engaged on the subterranean cable Turin–Milan–Genoa. The first section will be from Rome to Naples, and it is to be completed within thirty months. The other lines are to be laid successively, and all are to be completed within five years.

At the same time the Government is interested in a plan for large extensions to Italy's submarine cable system. It is stated that a new cable, to be laid shortly, will run from Anzio, passing between Corsica and Sardinia, to Barcelona. From Barcelona it will go on to Malaga, whence it will be taken on to meet the cables already existing in the Atlantic, which branch off, *viâ* the Canary Islands and Cape Verde to South America, and *viâ* the Azores to North America. The total length of the Anzio–Barcelona–Malaga cable, for which the Spanish Government has already given the necessary authorisation, is to be about 1100 miles. Later, a very long cable will be laid connecting Anzio directly with the Azores, which, it is anticipated, will greatly facilitate communication between Italy and North America.

WATER POWER ON THE RIVER CENISCHIA.

THE Cenischia, which is the principal stream in catchment of 130 square kilometres upstream of Susa, flows from the Mont Cenis Lake in a south-easterly direction. The watershed on the north and west coincides with the French–Italian frontier, and traverses summits of 3364 m., 2478 m., 3472 m., and 3200 m. The works for the storage and conveyance of the run-off of about one-third of the catchment and its utilisation at two hydro-electric power stations are described in *La Revue Générale d'Elécricité.* The surface of the Mont Cenis Lake is at altitude 1920 m. By means of one earthan and two masonry dams, the water level has been raised by about 10 m. and the capacity of the lake increased to 30,000,000 cubic metres. A tunnel, 1860 m. in length, conducts the water to a balancing well or shaft, excavated in the rock, whence it flows through pressure pipes to a power station of Gran Scala, alt. 1720 m., the vertical fall being 129 m. At Gran Scala there are three Pelton wheel sets of 1600 kilovolt-ampères, and one of 3000 kilovolt-ampères, 375 revolutions per minute. The tail water flows into the Saint Nicolas reservoir, which has a capacity of 50,000 cubic metres, and thence by a tunnel 5250 m. in length to another balancing shaft. This tunnel passes near a small tarn and under three streams, and the waters from all four are diverted to shafts, by means of which they enter the tunnel, the catchment utilised being thus considerably increased.

The tunnel ends at a point about 2 kiloms. from the Cenischia, and the pressure pipes between that spot and the power station of Venaus have a fall of 1100 m., or over 3600ft. This power station has three Pelton wheel sets, each of 21,200 kilovolt-ampères. The tail water of the station is received in a reservoir of 50,000 cubic metres capacity, which will serve as a regulator for a proposed station at Susa. The tri-phase, Brown-Boveri alternators, of 21,000 kilovolt-ampères capacity, furnish current at 7000 volts, 50 periods, and transformers raise the potential to 75,000 volts for transmission to the Turin network. The supply is augmented by current transmitted at 31,000 volts from Gran Scala.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

August Holidays.

UNDER the present anxious and difficult trading conditions industrialists in the Midlands and Staffordshire welcome the opportunity of taking a holiday, and in practically all works the August vacation will be of longer duration than is customary. Most engineering establishments, with the few rolling mills still able to operate, have been idle the whole of the week. Many mills, owing to the very unsatisfactory fuel available and the difficulty of producing at a profit, have closed down until the end of the strike. At some of the works stocktaking and machinery repairs have been carried out in preparation for any trade impetus which may be forthcoming when the present strike is over. Constructional engineers also ceased operations for a whole week. They are getting very short of steel, although they have in some cases several weeks' work in hand, with good business in prospect. There has been little done in the way of sales of iron and steel, and the attendance at the weekly meeting of the Midland iron trade in Birmingham to-day—Thursday—was extremely meagre. Many producers, merchants, and consumers were still on holiday, endeavouring to forget for a brief space the unsatisfactory conditions of the past three months and the difficulties yet to be met.

Steel.

In this area productive activity centres almost entirely on steel. A few small plants continue to turn out plates, beams, joists, sections, &c., but the substantial premium of £1 10s. per ton on the basis price of £7 7s. 6d. for sections is required, making the figure £8 17s. 6d. This addition to the price is sufficient to turn down a good deal of business. Bars have advanced to about £8 10s. Strip mills maintain a steady output. Light sections are being marketed in small quantities. For plates, millowners are prepared to negotiate for deliveries after the full resumption, but they want £8 15s. The general attitude to forward business remains apathetic and additions to order books are trifling. Many of the plants that are running complain of the irregular delivery of crude materials and semis, which have been bought from the Continent. There is pressure for sheet bars. Shippers are behindhand with their contracts and some of them are unable to entertain new business for execution before October. Belgian sheet bars were quoted to-day at £5 12s. 6d. to £5 14s. 6d. Business in billets at £5 6s. per ton is restricted. Consumers hesitate to pledge themselves in advance in the circumstances which now prevail. Engineers have been obliged to utilise foreign steel increasingly as the only means of getting through urgent contracts. Many builders, architects and others have in the past prohibited the use of foreign steel, but where the need is urgent they have allowed engineers to purchase abroad, and as the foreign steel makers are stated to be prepared to supply to a test of 28 to 32 tons, it is likely that the necessary conditions will be met. Some Midland constructional engineers are reported to be getting very short of steel, and yards with plenty of orders in hand will, it is feared, be obliged to close down.

Pig Iron.

The scarcity of raw iron has become a very serious matter for many local foundries and engineering works, and at the end of last week many of them would have been forced to close down even if the holiday had not intervened. Derbyshire and Northamptonshire brands are no longer obtainable, and though Cleveland and Scottish furnaces are able to supply in small quantities, the prices asked are considered prohibitive. Values of this iron have advanced further. They now range from £5 5s. to £5 10s. delivered Birmingham. The price irregularity in the hematite market is less marked. East Coast mixed numbers are quoted at about £5 or slightly less. Not only have founders and engineers to contend with dearer pig, but coke is becoming extremely scarce and dear, and the time has arrived when many consumers have decided not to incur further foundry losses, notwithstanding their anxiety to furnish castings sufficient to keep engineering works in operation. Consignments of continental pig iron are expected during next week, but their cost gives only a trifling advantage as compared with Middlesbrough pig iron, and the suitability to the requirements of foundries has yet to be tested. The situation is considered very grave.

Finished Iron.

Staffordshire ironworks continue at a standstill, with little prospect of an early resumption of activity. Stocks of bars have now come to an end and consumers must perforce buy from Lancashire where ironmasters, with foreign coal available, continue to turn out Crown bar iron. Prices, however, are extremely high and supplies are rarely heard of at less than £12 10s. per ton, which is 20s. above the pre-strike level. Lancashire works are at present benefiting at the expense of South Staffordshire, but whether this business will remain in their hands permanently can only be a matter of speculation. Black Country nut and bolt works and fencing manufacturers are working almost entirely on continental raw material. Complaints are heard of the irregularity of deliveries, and some works have been hard put to to continue regular operation. During the holidays it is hoped to augment stocks so that work may continue uninterruptedly when once again resumed.

Galvanised Sheets.

The galvanised sheet trade continues to book orders, but leading works have now raised their prices to £17 for delivery within four weeks, and £17 10s. for fourteen days. Thin plates of 30 gauge can be bought for about £22. It is reported that in some quarters orders are being withheld in the hope that present stringency may give way to easier conditions.

Fuel.

Rather more Midland fuel is coming to hand, but the bulk of the coal and slack available is of unsatisfactory quality. The foreign coal coming in is nearly all absorbed on the coast.

New Business.

Orders continue to be received by Midland rolling stock establishments both for home and export needs. The Metropolitan Carriage, Wagon and Finance Company, Birmingham, has a contract for 112 covered goods wagon of the "M.A.I." type, for the Jodhpur Railway. The Sentinel Waggon Works, Shrewsbury, have orders for an additional twenty-four light locomotives for the Egyptian Delta Light Railways; for one 15-ton locomotive for the Bhavnagar State Railway (metre gauge); six 6-ton locomotives to the order of the Indian Stores Department, for use on 2ft. 6in. gauge lines of Madras irrigation works; and two 25-ton double-geared locomotives for use at the shipyards of Cammell Laird and Co., Ltd., Birkenhead.

Birmingham Brass Trade.

The Birmingham brass trade continues in a flourishing condition, notwithstanding the fact that the general overseas trade has shrunk very much since the recovery of 1924. Some very good orders are coming in from Australia, and they and the requirements of the home market are the main factors in keeping the local foundries going at full pressure during this period of intermittent production in so many industries. The intensive house building programme now being pursued in Scotland, where steel construction is advancing very rapidly, is all to the good, and some Birmingham foundries find it no easy matter to keep pace with the demand for plumbers' brass-foundry and other fittings required for this market.

Mining Situation.

In the Warwickshire coalfield Monday last was generally observed as a holiday, but at Cannock Chase the mines were open and the men were willing enough to work. Some of the Warwickshire pits reopened on Tuesday and some on Wednesday. The numbers reporting for work vary from day to day, but at the time of writing they would appear to be pretty much what they were a week ago. In the Cannock Chase area, however, there has been a further decided increase, and that in face of the many meetings recently held and the intimidation which still continues, though in not to such an extent as in other districts. A fair tonnage of coal is being raised in the Midlands, but little of it is available for works consumption.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

A HOLIDAY atmosphere has been in evidence on the iron and steel markets here during the week, although, of course, as things are at present, it cannot be said that any appreciable difference has been or could be made to the position of British iron and steel. A number of foundries and engineering works, however, are closed down for the whole of the week. As regards the general outlook for the iron and steel consuming industries, it is regarded hopefully by a good many competent observers when conditions are such as to permit of unrestricted industrial operations. A useful addition to work to be carried out will be furnished by the Tramways Committee of this city, which proposes to purchase fifty new tramcars and to carry out alterations to 240 others at a total estimated cost of £410,000. Arising out of the recent acceptance by our neighbour, the Salford City Council, of a Dutch tender for electric cables, it is interesting to note that at the Council meeting this week the Electricity Committee was instructed to obtain particulars as to wages and labour conditions in the cable-making industries of Holland and Italy, together with information as to the increased cost of living in those countries.

Non-ferrous Metals.

A feature of the non-ferrous metals markets during the past week has been the fact that tin has

registered a further substantial gain in value. In my last letter I referred to the fact that a good many people here who are interested in this metal were regarding the £300 mark as within the bounds of possibility again. Whilst standard metal has not yet reached that point, sales of Straits and Dutch tin had been made at that figure during the past week. There is no doubt that the statistical position remains very strong. Official estimates place supplies during the six months ended June 30th at 31,506 tons, compared with 29,924 tons in the half-year ending December, while consumption, less exports and stocks at the end of the half-year, is given as 13,647 tons, compared with 8942 tons at the end of 1925. Apart from a fair volume of speculative buying of copper, there has been pretty heavy buying from consumers, more particularly by foreign interests, and prices have moved up again. In this section, also, the position is regarded as a strong one, an important factor being the heavy takings in the United States. In the case of spelter, in contrast with the other metals, the position on balance shows little change, although it is expected that prices will remain steady. With a fair amount of buying lead has maintained its firmness and higher values than those quoted a week ago have now to be paid for this metal.

Iron.

There seems now to be little belief in the iron markets here, of the rumours, referred to last week, of an agreement amongst Derbyshire ironmakers as to a price of 80s. per ton at the furnaces for No. 3 foundry iron for delivery when the mining dispute is settled. Discussing the position this week with a prominent maker, I was told that producers generally in the Derbyshire area are very much averse from committing themselves at this stage in respect of forward delivery, the outlook as regards fuel prices being altogether uncertain and the whole position being too speculative to justify serious commitments. As regards contracts entered into before the general strike, I was informed that there is still a big tonnage awaiting execution and that it would be dealt with as early as conditions permit at the contract prices, there being no intention, so far as this particular firm is concerned, of pleading strike clauses. For prompt delivery there is still a little Middlesbrough and Scottish No. 3 available at 100s. to 102s. 6d. per ton delivered Manchester or equal, East Coast hematite being quoted at about 94s. and some Middlesbrough high-silicon iron at about 107s. For delivery forward Scottish ironmasters are said to be offering No. 3 at 101s. per ton, Manchester or equal, which works out to 84s. 6d. at the furnaces. Before the strike Scottish iron was being sold on this market at about 94s. per ton delivered. There is no change in the position of manufactured iron, and Lancashire Crown bars remain nominal at £11 10s. per ton, with second quality bars quoted at £10 5s. In some instances merchants are still able to offer supplies from stock.

Steel.

Foreign materials are, of course, still dominating the steel market. Constructional engineers generally have been compelled to turn over to continental steel even where in pre-strike contracts British steel was specified, clients in most cases preferring to do so rather than have urgent work held up entirely. Most of the large buyers, however, are taking every precaution as regards quality and are having independent tests carried out before the material is shipped. The result is that most constructional firms are able to carry on with considerably less dislocation than would otherwise be the case. Alarmist reports have appeared in a section of the daily Press regarding the effect on the British iron and steel industries of the agreement between continental producers regarding exports. The fear is expressed that the result will be more intensive dumping of iron and steel into this country. It is pointed out to me on 'Change here that any movement of continental iron and steel prices will probably be towards higher levels. The differences between imported and British steels in some cases already amount to about 40 per cent., and that is regarded as quite sufficient to afford more remunerative prices to continental producers. Prices quoted here for imported materials keep steady, but in view of possible developments in the near future they are regarded as nominal, some makers declining to accept more business at present rates. Siemens plates range from £6 7s. 6d. to £6 10s. per ton, delivered to works in the Manchester district for cash against documents, with ship plates at about £6, sections at £5 17s. 6d., and joists at £5 12s. 6d. Some British re-rolling mills are still offering small steel bars at from £9 5s. to £9 10s. per ton, but other prices are nominal at about £11 10s. for boiler plates, £8 2s. 6d. for ship plates, and £7 7s. 6d. for joists and sections. During the past week there has again been a good volume of inquiry reported for most varieties, including boiler plates. Galvanised sheets are still attracting limited buying interest, but export prices keep very firm.

Scrap.

There is still very little business being done in iron and steel scrap. Non-ferrous scrap is in quiet demand, but values remain firm. For graded and sorted qualities, delivered to users' works, zinc scrap is quoted at £25 10s., lead at £31 10s., clean light copper £56 to £57, cast aluminium £83, heavy yellow brass £45, selected gun-metal £54, and brass rod turnings £39 to £40.

BARROW-IN-FURNESS.

General Quietness.

This being holiday week, what little that has been going on in the North-West District has been stopped. The stoppage only concerned the hoop works at Barrow, which throughout the strike has kept going with continental billets, and a few of the iron ore mines which have had a few men engaged. In Cumberland very little has been done of late, and there is no chance of an improvement until the coal dispute is ended. As far as coal is concerned there is no shortage now in this district. There are constant arrivals of cargoes from America and the Continent, and during the last week or two over 15,000 tons arrived. Some of the coal from the Continent came from as far as Alsace, and has been spoken of as being a steam coal. The local power station is using foreign coal, which is fairly satisfactory, except as regards price, which is practically double pre-strike rates. Vickers works are closed down for this week and will re-start next Tuesday. The Donaldson liner on the stocks is taking shape and it will not be long before she is ready for launching. She will be propelled by a Vickers internal combustion engine and will be generally similar to the previous motor ship built by Vickers Ltd. for the same line.

SHEFFIELD.

(From our own Correspondent.)

State of the Steel Trade.

THE production of semi-manufactured steel is still suspended on account of the shortage of coal, but the manufacturing and lighter branches of the local trade are continuing to carry on to a somewhat remarkable extent. How long they will be able to do so remains to be seen, for their present position is primarily due to the fact that large stocks of steel were on hand when the coal strike began, and those stocks are now approaching exhaustion. An illustration of the position is afforded by the announcement of a Rotherham firm, which states that it has been able to eke out its supplies of steel billets by the use of inconvenient sizes from steel makers' stocks, but expresses the fear that it will not be able to reopen the works after this week's holiday break. Other firms will be able to maintain activity for a longer period, but on all hands it is reported that stocks of material are running short. A good many sizes and kinds are exhausted already. Not a great deal of use can be made of foreign steel in Sheffield, as it is not of sufficiently good quality for many local purposes. When the coal dispute is settled there is sure to be a very large demand for raw and semi-finished steel, as some firms have large accumulations of orders on their books.

Automobile Steels.

Some falling off is reported on the heavy side of the steel trade, the demands from the shipbuilding, engineering and other industries showing a decline. It is not so, however, to any serious extent, with the motor industry. The supply of various special steels used in the construction of automobiles, both heavy and light, has become one of the most important branches of Sheffield trade. Very large stocks of these steels were in hand when the miners came out, and all requirements are still being promptly met. Owing to the state of the motor industry, the demand is of a rather uneven character, for, while some automobile firms are very busily engaged, others are only doing very moderately. A good deal of work also comes to Sheffield from the motor cycle and ordinary cycle trades, and the volume shows an increasing tendency year by year. There is a well-maintained demand for bright steel bars, but at several works stocks are running short, and it is possible that orders may be diverted to the United States, from which the main competition in this class of material comes. There is also a shortage of bright steel strip, and German material of that class is being imported into our market.

Cutlery and Plate.

There is not much change to report in the condition of the cutlery and plate branches, and, as August is always a quiet month for them, no substantial improvement is to be expected for some time. Not only are orders on an unsatisfactory scale, but prices and profits also leave much to be desired. The tendency on the part of some of the best colonial markets to buy increasing proportions of cheaper goods continues to grow.

Important Colliery Amalgamation.

The first important amalgamation of colliery interests to take place in Yorkshire since the recommendations of the Royal Commission were published is now announced. It has been effected between the South Kirkby, Featherstone and Hemsworth Collieries, Ltd., of Pontefract, and the Ackton Hall Estate, Collieries, Coke Ovens, and By-product Plant. The South Kirkby Company has acquired all the shares of the Ackton Hall Company held by the trustees of the late Lord Masham. The two concerns are near neighbours; in fact, certain of their workings and royalties adjoin. The South Kirkby Company is already the largest colliery company in Yorkshire. The area of its coalfield exceeds 20 square miles, and, employing nearly 10,000 workpeople, it has an annual production of over 2,000,000 tons of coal. The Ackton Hall Company has an output of some 650,000 tons. The combined undertaking will possess thirteen up-to-date collieries, besides coke ovens, brickworks, and tar and benzol distillation plants.

Coal Find near Lincoln.

The belief that the Barnsley seam of coal extends in an eastward direction beyond the limits of present workings has been confirmed by the results of boring at Harby, a few miles west of Lincoln. The Lincolnshire Boring Syndicate, which has been engaged in the operations at Harby for some time, announces that a seam of coal was struck at a depth of 902 yards. It has been identified by the Geological Survey as the Top Hard or Barnsley seam, and as a continuation of the seam struck at 850 yards deep near Retford. As the Retford and Harby borings are 12 miles apart, and the seam dips 52 yards in that distance, it is deduced that if the same angle of dip is maintained, the seam should be found workable right through the county of Lincoln. The last seam found at Harby is at a depth of 1106 yards, and this has been identified as the Deep Soft. On the authority of Mr. W. H. Chambers, one of the directors of the syndicate, and for many years manager of the Denaby and Cadeby Collieries, Ltd., it is stated that the Top Hard seam is workable, under ordinary conditions, at the depth at which it has been found at Harby. Another matter of mining interest is the discovery of a valuable outcrop at Boythorpe, near Chesterfield, where a grass field has been transformed into a miniature colliery employing between 200 and 300 miners, all of whom are trade unionists living in Chesterfield, Sheffield and other places. A 6ft. seam of coal has been found, only 5ft. below the surface, and it is worked from eighteen holes. A considerable output has already been obtained, and is increasing. The coal is of good quality, and several local firms which have used it for steam-raising purposes speak very highly of it. There has also been an outcrop find in a field on a farm at Darnall, Sheffield. The seam is fairly large, and consists of Hazel coal, which is stated to be of excellent quality.

Steel Trade with Spain.

The Sheffield steel trade with Spain is very seriously threatened by the new Spanish Royal Decree, dated July 14th, which affects the export to that country of fine carbon steels, including alloy and high carbon steels. The decree is calculated to keep out all foreign competition, and to force steel users in Spain to purchase from local users. There remains some means by which a customer can obtain Sheffield steel if he urgently desires it, but they are of a very cumbersome character, and entail application for three certificates from different Spanish authorities. The decree is regarded here as practically prohibitive. At present it will affect all steels containing 6 per cent. carbon or upwards, but it is pointed out that it is quite probable that in the near future the remaining clause of the tariff, under which ordinary steels can be exported to Spain, will also be applied, with the result that the market would then be automatically closed to practically all Sheffield products in the form of steel in bars. The Sheffield Chamber of Commerce is taking the matter up energetically. It has made very strong representations to the Commercial Relations and Treaties Department of the Board of Trade. Sir Arthur Balfour has had interviews with the President of the Board of Trade and officials of the Foreign Office. The Chamber is also arranging for questions to be asked in the House of Commons, so as to give the fullest possible publicity to the difficulty. It is urged that the policy of the Spanish Customs authorities is both exclusive and unfair, especially in view of the extent to which this country purchases the products of Spain.

Orders for Rolling Stock.

There are a good many important inquiries afoot just now with regard to railway materials, and several interesting orders of this kind have been announced during the past week. The Leeds Forge Company, which is a subsidiary of Cammell Laird and Co., Ltd., Sheffield, has received from the Crown Agents for the Colonies a contract for the following new freight rolling stock required for service on the Tanganyika Railways (metre gauge):—Twenty 25-ton all-steel covered wagons; sixteen 25-ton high-sided wagons; thirty bogie low-sided wagons; and twenty-four 10-ton low-sided wagons. Clayton Wagons, Ltd., Lincoln, is to supply four four-wheeled goods brake vans, two four-wheeled underframes, ten four-wheeled cattle wagons, and one four-wheeled underframe. The Lincoln firm is also to build six four-wheeled bogie petroleum tank wagons for the Union of South African Railways. The firm of G. R. Turner, Ltd., of Langley Mill, Notts., has been awarded, among other orders, one for twenty bogie tank wagons, for the conveyance of naphtha, for the Central Argentine Railway.

NORTH OF ENGLAND.

(From our own Correspondent.)

The Trade Position.

THE intervention of the August holidays has served to accentuate the quietness prevailing in industrial circles in the North of England. Business in all sections has been almost at a standstill this week. Ample supplies of foreign fuel are now arriving to meet the requirements of those iron and steel producers who still have plant in operation, but much complaint is heard that the cost of keeping machinery in motion is such as does not admit of works being run at a profit, and that in many cases commodities are being manufactured at an actual loss.

Cleveland Iron Trade.

To seek to buy Cleveland pig iron just now is to embark upon an almost hopeless quest. With the exception of two furnaces making this commodity at the works of Bolckow, Vaughan and Co., Ltd., producing plant is inoperative, and stocks are now very low. No. 3 Cleveland pig iron, which is most needed, is now practically unobtainable. Export business is, of course, at an absolute standstill. On the other hand, considerable quantities of continental pig iron, which have been held up by the recent strike at Antwerp and the consequent congestion, are now coming forward, but all of them vary in price substantially below that of Cleveland pig iron. Several descriptions of foreign material, however, are less easy to obtain than they have been. Some firms abroad are understood to have booked orders as extensively as they care to for the present, and higher prices are being asked for imported materials. Quotations are unchanged, No. 1 Cleveland foundry iron being 92s. 6d.; No. 3 G.M.B., 90s.; No. 4 foundry, 89s.; and No. 4 forge, 88s. 6d. per ton.

Hematite Pig Iron.

A slightly better feeling is noticeable in the East Coast hematite pig iron trade. Unsold stocks, though still fairly heavy, are being steadily reduced, and the improving statistical situation is strengthening the hands of sellers. Buyers, however, report that they experience no difficulty in placing orders for mixed numbers at 81s. and No. 1 at 81s. 6d. per ton.

Ironmaking Materials.

There is complete stagnation in the foreign ore trade. Large quantities are still coming forward under running contracts, but very little is being used, and stocks

are exceedingly heavy. High prices are being realised for blast-furnace coke.

Manufactured Iron and Steel.

Manufactured iron and steel works promise to be busy when conditions permit of the now idle machinery being once more set in motion, and there is reason to believe that quotations will be advanced when the coal stoppage ends. There is rather more demand for semi-finished steel materials, and sellers, anticipating an upward movement in prices, with increasing scarcity of supply, are inclined to hold off the market.

Wages Increase for Ironworkers.

The average net selling price of manufactured iron on the North-East Coast for the two months ending June last was £13 19s. 11·63d. per ton. In accordance with the sliding scale arrangement there will be an advance of 25 per cent. in puddlers and other forge and mill workers' wages as from Monday last. Wages of steel smelters under the sliding scale agreement will be reduced by 1¼ per cent.

Eight Shipyards Closed on the Wear.

There was only one ship launched from the Sunderland shipyards during the month of July. This makes a total of four vessels, aggregating 20,780 tons, produced on the Wear during the seven months of the present year, compared with sixteen vessels and 63,676 gross tons launched during the first seven months of last year. The position of the industry on the Wear is deplorable. Of the fourteen yards on the river, no fewer than eight are closed down.

Iron and Steel Exports.

The position of the iron and steel export trade could not be worse. Not for many years has so small a tonnage been exported from the Cleveland district as during the month of July. By ruthless price cutting prior to the coal stoppage producers had succeeded to some extent in meeting the competition in overseas markets, but the stoppage of production has enabled the foreign producers to once more step in and to capture most of the business that is going. Undoubtedly a grave situation confronts English producers when they are able to resume operations at their works, and have once more to compete in the world's markets for business. Not only will prices be higher, but they will be cut out of the continental markets owing to the depreciation of the currency, which has given French and Belgian producers a big advantage. The July shipments of pig iron totalled only 6736 tons, of which 4520 tons went foreign, and 2216 tons coastwise, as compared with a total of 23,640 tons—18,350 tons foreign and 5290 coastwise—in June. The exports of manufactured iron and steel amounted to 32,637 tons, of which 28,475 tons went foreign and 4162 tons coastwise, as against a total of 44,237 tons in June.

The Coal Trade.

The Northern coal trade remains idle. Although there is a confident feeling that August will see a settlement of the dispute, the position is so problematical that fitters will not risk committing themselves, and all inquiries are still being held up. There is no further development in the import coal trade. Stocks of coal locally are ample to meet current requirements, and buyers of foreign coal show no disposition to commit themselves beyond a few odd lots.

SCOTLAND.

(From our own Correspondent.)

Clyde Shipbuilding.

The tonnage output from Clyde yards during the month of July was extremely low and simply goes to confirm the fact that the industry has sustained a serious setback. The outlook has not improved to any extent, and in all probability the present year will represent one of the poorest in the history of the shipbuilding trade. From reports to hand, the shipping at present on order on the Clyde is less than 338,000 tons, which, compared with two years ago, shows at least a decrease of 50 per cent. New contracts are still reported, but the total volume is much less than the quantity required to establish a semblance of prosperity. During the month of July twelve vessels of 12,897 tons aggregate were launched from Clyde yards. Included in the returns were the cargo steamers Dalblair, 4700 tons, for the United Steam Navigation Company, Ltd., London; Baron Ogilvy, 3400 tons, for H. Hogarth and Sons, Glasgow; and the Waipiata, 2800 tons, for the Union Steamship Company of New Zealand, Ltd. Contracts reported during July are as follows:—A second cargo steamer of 10,500 tons, for the Canadian Pacific Railway, to be built by Barclay, Curle and Co., Ltd., of Whiteinch; a motor ship of 6500 tons gross, by Messrs. Scotts, of Greenock, for Alfred Holt and Co., of Liverpool; a motor vessel of 60ft. in length, to be built by Harland and Wolff, Govan, for Elder, Dempster and Co.'s West African service; besides one or two small motor boats. The C.P.R. order mentioned above is one of a group of seven, all of which have now been placed as follows:—Two passenger liners, 18,000 tons each, and five cargo steamers, 10,500 tons each. One passenger liner will be built by John Brown and Co., Ltd., of Clydebank, and the other by William Beardmore and Co., Ltd., Dalmuir; two of the freight carriers will be built by Barclay, Curle and Co., Ltd., of Whiteinch, and one by William Denny and Brothers, Ltd., of Dumbarton. The other two orders have been placed with Sir W. G. Armstrong, Whitworth and Co., Ltd., at Newcastle-on-Tyne.

Steel and Iron.

Practically nothing has been done in the steel and iron trades during the past week. With the exception of the light foundries in the Falkirk district, few, if any, of the works are in operation, and the restart is likely to be postponed until the miners' strike is settled. The production of steel is very limited. Sheets have fair orders on hand, but the current inquiry is not too satisfactory. Prices remain on a high level, however. Bar iron makers have nothing fresh to report. All brands of pig iron are very scarce, and a further upward tendency in prices is noticeable. Local consumers of steel and iron are, in many instances, utilising imported materials to some extent.

Coal.

There is little or no change in the Scottish coal trade. Supplies of imported fuel are plentiful, but the price is too high to permit many industrial users to purchase. Cargoes arrive regularly, and no difficulty is experienced in maintaining the emergency reserve of 20,000 tons. A steamer arrived at Greenock from Stettin during the week with a cargo of Silesian dross, which will be absorbed by the local sugar refineries. Since the rationing of domestic fuel began 400,000 tons of coal have been distributed in Scotland, which represents a great reduction in the ordinary supply and demand.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Outlook.

Hopes of an early restart of work in the coalfield have rather diminished as the result of the decision of the national delegate conference of Friday last. It was thought that some recommendation would have been forthcoming that would be more likely to form the basis of a settlement than the Church formula, which has been referred to the districts for their approval or otherwise. The South Wales delegates to that conference opposed the Church memorandum, and there is no reason to think that they will alter their attitude as the outcome of the delegate conference which has been called for Saturday next to consider the matter. There have already been meetings of miners in this district, at which resolutions have been passed instructing their representatives at next Saturday's conference at Cardiff to vote against the proposals and to continue the struggle. Taking the country all through, the Church memorandum may have a majority, but even if this is the case it is feared that the proposals in question will meet with the opposition of the coalowners and the Government. The best that can be hoped for is that, at any rate, from the movement initiated there will emerge direct negotiations between the parties concerned, and that a settlement will be hammered out. This, however, will take some time, and it is for that reason that there is now little expectation of work this month, notwithstanding the rumours emanating from the coalfield that many miners are tired of their inactivity and that the leaders have great difficulty in restraining them from returning to work.

Coal Imports and Prices.

Up to the present time approximately 3½ million tons of American coal have been arranged for shipment to this country, since the commencement of the stoppage of work, and it is reliably computed that the imports of American and Continental coal to South Wales ports so far amount to about 300,000 tons. During the past week coals from abroad have been coming to ths district on a considerable scale, and very substantial supplies are shortly due. Actual fresh business is on rather quieter lines, and doubtless will continue so throughout this week, until it can be better gauged what the chances are of the stoppage being prolonged. If there are no signs of an early settlement, then there is no doubt that fresh cargoes, more particularly from the Continent, will be arranged, as supplies for industrial and domestic purposes are certain to be needed badly. Following on the decision of the coalowners to raise the price of large coal from 25s. to 45s. per ton plus freightage, the Cardiff coal merchants have agreed that for the time being at least the price of coal per cwt. to householders for all grades of coal and fuel should not exceed 3s. per cwt.

Coalfield Items.

A certain amount of trouble has been experienced in some districts in South Wales, safety men having been interfered with by miners under the belief that coal was being produced for commercial purposes. The most serious case was at the Cwncarn Colliery, where the management intimated that if there was no restoration of peace the colliery would be closed down immediately for an indefinite period. This colliery normally employs about 900 men. The Ocean Coal Company has decided to close down the Dare pit at Cwmpare, owing to its having proved unremunerative for a number of years. This colliery, when working, employed 1200 men. Considerable indignation prevails in the Caerphilly district by the decision to pay out to unemployed miners living in the East Glamorgan district, money subscribed to the Caerphilly District Miners' Hospital Fund. Out of a total sum of £16,000 subscribed, £10,000 is to be paid out, and the first instalment was made on Saturday last of 5s. per member. Another 5s. is to be paid out next week, and a further distribution of 6s. per man the following week. These disbursements are described as "refundments." Counsel's opinion has been taken upon this action, which is declared to be entirely illegal, and the trustees and committee incur full personal responsibility. The sum of £16,000 had been subscribed by colliery companies, all classes of colliery workers and others in the district.

Central Selling Agency.

The Cardiff Coal and Shipping Exchange Committee of Control has passed a resolution opposing the Mines (Reorganisation) Bill, and also expressing opposition to the system of central selling agencies. Its view is that such a scheme would prove a menace to the future of the coal trade. The Bristol Channel District Association of Shipbrokers has also declared by resolution that a central selling agency for coal is undesirable and would be detrimental to the interests of the coal trade and the general community. It further states that it will resist by all legitimate means any attempt to interfere with the principle of the freedom of individual trading.

Loss of Trade.

The returns issued by the Great Western Railway Company relating to the docks under its control in this district show that up to July 11th last imports and exports had this year amounted to 14,300,772 tons, whereas for the same period of last year the figure was 19,473,896 tons, so that the loss of trade amounted to over 5,000,000 tons, due entirely to the stoppage of work in the coal industry. Coal and coke exports during that period declined to the extent of over 4,800,000 tons.

Coal Trimmers and Reduced Tariff.

In connection with the proposed new tariff which employers intend enforcing as from the 16th inst., the coal trimmers have been balloted by their leaders and the result of the ballot of the Cardiff, Penarth and Barry men is that 982 were in favour of referring the matter to a court of inquiry, 343 in favour of authorising their delegates to obtain the best terms, and 57 were in favour of strike action.

Ship Repairing Order.

There has been no improvement in the ship-repairing industry generally of this district, though one order of fair magnitude has just been secured by the Penarth Pontoon Slipway and Ship-repairing Company, Ltd., this being for the repair of the ss. Daybeam, which sustained bottom damage through grounding when trading recently in the Baltic. The contract is in the neighbourhood of £2000, and was secured in competition with other South Wales and North-East Coast firms.

Siemens Steel Trade.

An application came before the Joint Standing Committee of the South Wales Siemens Steel Association last week for an increase in the sliding scale rate from 10 to 20 per cent. which should become the minimum. The figure of 20 per cent. was in operation up to May 30th last, but was reduced owing to the depression in the trade. The Committee decided, however, to make no variation, but the employers intimated that if during the currency of the present ascertainment business became again normal, the Iron and Steel Trades Confederation had the right to renew its claims.

Tin-plate Trade.

Owing to the holidays there was no meeting of the Metal Exchange on Tuesday, but prices of tin-plates remain unaltered, viz., 25s. to 25s. 6d. bases I.C. f.o.b. works port, for prompt supplies, and 20s. 3d. for forward delivery.

Terms Rejected.

The directors of the Blackbrook Colliery Company, Caerphilly, have offered their workmen terms similar to those prevailing before the stoppage, provided that when a national agreement is reached it shall become operative. The men have rejected the offer. The colliery normally employs about a hundred men.

South Wales Delegate Conference.

The Executive Council of the South Wales Miners' Federation met on Tuesday to make arrangements for Saturday's delegate conference. The Council refrained from making any recommendation, though a week previous the Committee strongly condemned the National Executive's acceptance of the memorandum of the Christian Industrial Fellowship.

CATALOGUES.

Leyland Motors, Ltd., Leyland, Lancs.—Booklet of "Trojan" service stations.

Hathorn, Davey and Co., Ltd., Sun Foundry, Leeds.—General catalogue for 1926 of pumping and hydraulic machinery.

R. A. Evans, Ltd., Prospect-road, Leicester.—Catalogue describing the various types of lifts made and giving a list of some of the users.

Drabble and Sanderson, Ltd., Savile-street, Sheffield.—A pamphlet describing a school for saw doctors recently established by the firm.

Glenfield and Kennedy, Ltd., Kilmarnock.—Brochure dealing with the improved type of "Glenfield" electrically operated sluice valve.

Tangyes, Ltd., Cornwall Works, Birmingham.—"A Brief History of the Cornwall Works," describing the growth of the firm from 1869 to 1920.

The McGraw-Hill Publishing Company, Ltd., 6, Bouverie street, E.C. 4.—List No. 3 of books on chemistry, and list No. of books on civil engineering.

The English Electric Company, Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. 745, entitled "The Motor that Meets the Requirements of the User."

University of Bristol.—A prospectus of the Faculty of Engineering, which is provided and maintained by the Society of Merchant Venturers in the Merchant Venturers' Technical College, Bristol, has just reached us. Courses of study are available at the College for persons intending to engage in civil, mechanical, electrical, or automobile engineering, and particulars of those courses are given in the prospectus. The ordinances and regulations relating to degrees and diplomas in engineering subjects are included, and some particulars of the Bristol sandwich system of training engineers are also given. The prospectus can be obtained from the Registrar of the Merchant Venturers' Technical College, Bristol

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
Native	18/6 to 21/-
(1) Spanish	18/6 to 21/-
(1) N. African	18/6 to 21/-
N.E. Coast—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	4 2 6	—
No. 1 Foundry	4 10 0 to 4 15 0	
No. 3 Foundry	4 5 0	—
N.E. Coast—		
Hematite Mixed Nos.	4 1 0	4 1 0
No. 1	4 1 6	4 1 6
Cleveland—		
No. 1	4 12 6	4 13 0
Siliceous Iron	4 12 6	4 13 0
No. 3 G.M.B.	4 10 0	4 10 6
No. 4 Foundry	4 9 0	4 9 6
No. 4 Forge	4 8 6	4 9 0
Mottled	4 8 0	4 8 6
White	4 8 0	4 8 6
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 5 0 to 3 10 0	
,, Forge	2 15 0 to 2 17 0	
(3) Derbyshire—	(*None offered.*)	
No. 3 Foundry	3 7 6 to 3 15 0	
Forge	3 2 0 to 3 5 0	
(3) Lincolnshire—	(*None offered.*)	
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 8 6 (a); 4 12 0 (b); 4 16 0 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	11 5 0	11 0 0
Best	—	—
N.E. Coast—		
Common Bars	11 5 0	—
Lancs.—		
Crown Bars	11 10 0	—
Second Quality Bars	10 5 0	—
Hoops	14 0 0	—
S. Yorks.—		
Crown Bars	12 10 0	—
Best Bars	13 10 0	—
Hoops	14 10 0	—
Midlands—	(*Prices nominal.*)	
Crown Bars	11 5 0 to 11 10 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 10 10 0	
Gas Tube Strip	12 10 0	—

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) Scotland—		
Boiler Plates	11 0 0	—
Ship Plates, ½in. and up	7 7 6	7 0 0
Sections	7 12 6	6 5 0
Steel Sheets, under 3/16in. to ¼in.	11 0 0 to 12 0 0	
Sheets (Gal. Cor. 24 B.G.)	— £17 0 0 to £18 0 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 0 0	—
Angles	7 10 0	—
Boiler Plates	11 10 0	—
Joists	7 10 0	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. Coast—		
Barrow—		
Heavy Rails	8 0 0†	—
Light Rails	8 5 0 to 8 10 0	
Billets	8 0 0 to 10 10 0†	
Manchester—		
Bars (Round)	9 5 0	—
,, (others)	9 0 0	—
Hoops (Best)	13 5 0	13 0 0
,, (Soft Steel)	10 0 0	9 15 0
Plates	8 2 6	—
,, (Lancs. Boiler)	11 10 0	—
Sheffield—		
Siemens Acid Billets	10 0 0	—
Bessemer Billets	11 0 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
Midlands—		
Small Rolled Bars	7 15 0 to 8 10 0	
Billets and Sheet Bars	6 2 6 to 6 7 6	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	17 0 0 to 17 10 0	
Angles	7 7 6 to 8 17 6	
Joists	7 7 6 to 8 17 6	
Tees	8 7 6 to 9 17 6	
Bridge and Tank Plates	7 17 6 to 8 15 0	
Boiler Plates	11 0 0 to 11 15 0	

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	21/3 to 25/6
Block Tin (cash)	289 7 6
,, (three months)	284 5 0
Copper (cash)	58 7 6
,, (three months)	59 6 0
Spanish Lead (cash)	33 7 6
,, (three months)	33 0 0
Spelter (cash)	34 7 6
,, (three months)	34 16 3
Manchester—	
Copper, Best Selected Ingots	65 15 0
,, Electrolytic	67 15 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 0½
Brass Tubes (Basis Price)	0 0 11½
,, Condenser	0 1 2
Lead, English	34 17 6
,, Foreign	32 15 0
Spelter	34 15 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/10½ per lb.	
Ferro Tungsten	1/5 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£22 10 0	7/6
,, 6 p.c. to 8 p.c. ,,	£22 0 0	7/3
,, 8 p.c. to 10 p.c. ,,	£20 15 0	6/6
,, Specially Refined		
,, Max. 2 p.c. carbon	£38 10 0	12/6
,, ,, 1 p.c. ,,	£44 10 0	15/-
,, ,, 0·70 p.c. carbon	£54 10 0	17/6
,, ,, carbon free	1/5½d. per lb.	
Metallic Chromium	3/3 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 5 0	scale 5/- per unit
,, ,, 75 p.c.	£20 10 0	scale 6/- per unit
,, Vanadium	15/- per lb.	
,, Molybdenum	6/- per lb.	
,, Titanium (carbon free)	0/11 per lb.	
Nickel (per ton)	£170	
Cobalt	10/- per lb.	
Aluminium (per ton)	£112	

FUELS.

	Export.
Scotland. (*Prices nominal.*)	
Lanarkshire—	
(f.o.b. Glasgow)—Steam	15/9
,, ,, Ell	16/6
,, ,, Splint	16/6 to 17/-
,, ,, Trebles	15/9
,, ,, Doubles	14/- to 14/6
,, ,, Singles	13/9
Ayrshire—	
(f.o.b. Ports)—Steam	16/9
,, Jewel	17/- to 17/6
,, ,, Trebles	17/-
Fifeshire—	
(f.o.b. Methil or Burntisland)—Steam	12/6 to 14/9
Screened Navigation	21/-
Trebles	14/- to 15/-
Doubles	14/-
Singles	13/- to 13/6
Lothians	
(f.o.b. Leith)—Best Steam	14/- to 14/3
Secondary Steam	13/6
Trebles	14/6 to 14/9
Doubles	13/6
Singles	13/6
England.	
(8) N.W. Coast—	
Steams	*No quotation*
Household	,, ,,
Coke	,, ,,
Northumberland—	
Best Steams	16/-
Second Steams	14/6 to 15/-
Steam Smalls	8/- to 8/6
Unscreened	13/- to 13/6
Household	20/- to 22/-
Durham—	
Best Gas	18/6 to 19/-
Second	15/- to 15/6
Household	20/- to 22/-
Foundry Coke	18/- to 20/-

Sheffield	Inland. (*Nominal: none on offer.*)
Best Hand-picked Branch	31/- to 34/- —
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	26/- to 28/- —
,, ,, House	24/- to 25/- —
,, ,, Large Nuts	17/- to 20/- —
,, ,, Small	12/6 to 14/- —
Yorkshire Hards	17/- to 19/6 —
Derbyshire Hards	16/- to 19/- —
Rough Slacks	10/- to 12/6 —
Nutty Slacks	7/6 to 9/- —
Smalls	3/6 to 6/- —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 16/- to 17/

Cardiff— (9) South Wales. (*All prices nominal.*)	
Steam Coals:	
Best Smokeless Large	26/- to 27/-
Second ,, ,,	24/6 to 25/6
Best Dry Large	24/- to 25/-
Ordinary Dry Large	21/- to 22/-
Best Black Vein Large	25/6 to 26/-
Western Valley Large	24/6 to 25/-
Best Eastern Valley Large	24/- to 25/-
Ordinary ,, ,,	23/6 to 24/-
Best Steam Smalls	17/- to 18/-
Ordinary ,,	16/- to 17/-
Washed Nuts	19/- to 20/-
No. 3 Rhondda Large	26/6 to 27/-
,, ,, Smalls	18/- to 18/6
No. 2 ,, Large	24/- to 25/-
,, ,, Through	20/- to 21/-
,, ,, Smalls	15/- to 16/-
Foundry Coke (export)	40/- to 50/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	45/-
Pitwood (ex ship)	26/6 to 27/6
Swansea—	
Anthracite Coals:	
Best Big Vein Large	39/- to 40/-
Seconds	32/6 to 35/-
Red Vein	27/- to 29/-
Machine-made Cobbles	47/6 to 50/-
Nuts	47/6 to 50/-
Beans	42/6 to 44/-
Peas	23/- to 25/-
Breaker Duff	7/6 to 8/-
Rubbly Culm	12/6 to 13/6
Steam Coals:	
Large	22/6 to 24/6
Seconds	20/- to 22/-
Smalls	11/- to 15/-
Cargo Through	16/6 to 17/6

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Industrial Charges.

In seeking to readjust national finances without calling in the aid of foreign capital the new Government is placing burdens upon industry which should, logically, have an immediate effect in restricting activity. On all sides it is affirmed that the country can only be saved by an intensive production, but the production is obviously limited by the capacity of consumption, and that depends upon the cost at which goods can be manufactured. Again, temporary expedients in the way of specially heavy taxes and charges invariably have permanent effects. Competition alone can bring down values from the level at which they have been inflated by higher costs. The direct charges on industry do not, of themselves, constitute a particularly grievous burden. The 2 per cent. tax on turnover is an average of the three graduated taxes already existing, while the tax on exports is 8·3 per cent., except in the case of luxury goods, which will support an export tax of 12 per cent. The participation of the State in industrial and commercial profits above a moderate minimum is 15 per cent. Manufacturers will certainly be more seriously affected by the indirect charges, such as the increase in railway rates to the extent of 32·5 per cent. on passenger fares and 11·5 per cent. on merchandise freights. These may, indeed, be still further increased, for the railway companies consider that they themselves must derive more revenue from the traffic if they are to cover their steadily increasing expenses. So far the repeated increases in railway rates during the past two years have resulted in proportionate additions to revenue, but a point will certainly be reached at which the rate of progression will slow down or fail altogether. On the inland waterways the rates will be increased 8 per cent. for the benefit of the State. These increases will not apply to foodstuffs and certain other goods. The new system of taxation aims at preventing as far as possible any further inflation in living costs, but as it falls more or less on everybody, the cost of living must necessarily increase, especially as wages tend constantly to advance. Manufacturing costs will therefore rise, and makers themselves will be protected by higher import duties. The Government has decided to abandon the 30 per cent. increase which came into operation last April and has been found inoperative generally on account of international complications. It seeks powers to modify the coefficients as required in order to adjust the import duties to actual money values until such time as the new Tariff Bill is introduced and becomes law. It is to be presumed, therefore, that the import duties will almost immediately undergo a substantial increase. Manufacturers are endeavouring to obtain some compensation for these additional charges by a modification of the eight hours' working day, which is really a dead letter in most continental countries, and even in Germany the law leaves so many loopholes for longer hours that a nine hours' day has become a general rule. In this country it is recognised that the law has given disastrous results, and as everything must be done to favour production it is highly probable that the eight hours' working day will soon be a thing of the past.

Rail Motors.

As charcoal is the only "national" fuel which is at present giving satisfaction, and may prove generally economical if only supplies can be procured at a sufficiently low cost, the National Office of Liquid Fuels has decided to organise next year a trial of rail motors running on suction gas with charcoal as a fuel. Quite a number of rail motors are used in Paris for shunting purposes, and the few which are employed on local lines for passenger service are giving results that justify their use if only the cost of fuel is kept within reasonable limits. There is still a belief that the local railways can only be saved by the internal combustion engine, but the cost of petrol and other oils increased so rapidly with the depreciation of the franc that it is feared it will be almost impossible to employ imported liquid fuels for commercial purposes in the future. In view of the results already obtained on commercial vehicles with suction gas engines employing charcoal, it is reasonable to suppose that the fuel will prove satisfactory on rail motors, but the economy of suction gas will depend entirely upon the success of the efforts now being made to simplify the methods of carbonising wood so that abundant supplies of charcoal can be obtained at low cost.

The Navy.

In the course of one week the Permanent Trials Commission has officially received the two 8000-ton cruisers Duguay-Trouin and Lamotte-Picquet, the two destroyers Jaguar and Chacal, three torpedo boats of 1400 tons, and two submarines of 1150 tons. All of them belong to the first batch of ships built under the new programme. The results obtained with the cruisers are declared to have been particularly brilliant. The Duguay-Trouin attained a speed of 33 knots. The turbines developed 118,000 horse-power, and the consumption of oil fuel was 800 kilos. per nautical mile. In some quarters regret is expressed at the complete absence of armament, which has been sacrificed to the speed and rapidity of manœuvring that are essential in ships designed specially for mobility. The vessels appear to inaugurate successfully a new navy that is intended to fulfil special conditions of defensive strategy.

Railway Accident.

An express train on the Est line was approaching Noisy-le-Sec near Paris when it crossed points at a speed of 52 miles an hour. The locomotive left the rails and turned over, the coaches being telescoped into each other. Four sorters in a postal wagon were killed and seventeen injured. The driver declares that on account of the mist he did not see the signal about 180 yards from the points until he was close up. At the same time it is affirmed that the driver must have known that he was about to pass from one line to another.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

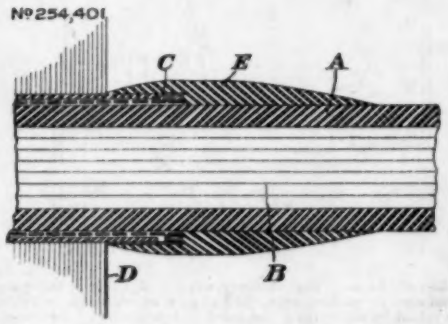
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

254,401. April 4th, 1925.—IMPROVEMENTS IN AND RELATING TO DYNAMO-ELECTRIC MACHINES, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2, and Frank Percy Whitaker, of 237, Clifton-road, Rugby.

When the windings of high-voltage machines are being flashed, it is impossible to prevent corona forming along the inside of the slots and around the ends of the slots if the ordinary winding is used, and the object of this invention is to provide a corona protection shield preferably within and extending beyond the core laminations and embedding the extended end of the



corona shield in insulating material. A layer of insulation A surrounds the conductors B, and where the conductors emerge from the slot a corona shield C is wound round the insulation, and it extends for some distance beyond the laminations. The shield may consist of a thin metallic strip spirally wound, and having its outer end electrically connected to the laminations by a conductor D. The outer end of the shield is embedded in insulating material E, which may be moulded in place. This insulation must be comparable with the strength of the insulation A, surrounding the conductors, and it should be so applied that it is solid and all air is excluded.—*July 5th*, 1926.

BATTERIES AND ACCUMULATORS.

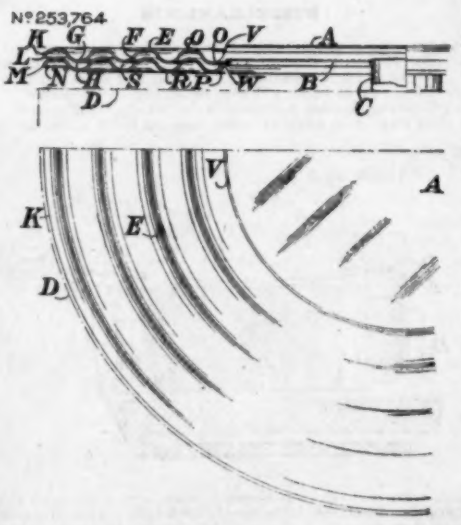
254,209. January 12th, 1926.—IMPROVEMENTS IN METALLIC COMPOSITIONS AND METHOD OF MAKING THE SAME, Adolph Miller, of 716, North Kirkwood-road, Kirkwood, Missouri, America.

The inventor claims to have found by experiment that the metallic composition described in this specification is very suitable for making storage battery plates on account of its great porosity, as compared with lead, its high electrical conductivity, its rigidity and its non-corrosive properties. Battery plates made in accordance with the invention are said to be immune from the electrolytic action of the cell. The improved composition is composed of about 90 per cent. pure lead and about 10 per cent. of redistilled mercury by weight. The lead is melted in a closed receptacle, provided with a removable cover. The mercury is heated in a separate closed vessel to boiling point, and it is then conducted into the melted lead, without permitting the escape of gas. When the mercury is being mixed with the lead, sufficient heat is maintained to keep the mixture of lead and mercury up to the boiling point of the mercury, and the mixture is constantly agitated, so as to mix the two together. After the composition has been prepared in this manner the mixture is drawn off, after its temperature has dropped below the boiling point of mercury, into moulds, and is allowed to cool.—*July 1st*, 1926.

TRANSFORMERS AND CONVERTERS.

253,764. September 24th, 1925.—IMPROVEMENTS IN OR RELATING TO EXPANSION CHAMBERS FOR OIL-COOLED ELECTRIC TRANSFORMERS, The British Electric Transformer Company, Ltd., of Hayes, Middlesex, and Derwent Pearce Flockart, of the same address.

The transformer expansion chamber described in this specifi-

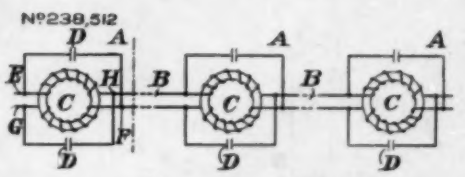


cation consists of upper and lower metal discs A and B, forming end walls, the lower of which, namely, B, is provided with a tubular extension C, which is connected to the casing D of the oil-cooled transformer. A number of corrugated metal sheets E, F, G and H flexibly connect the discs A and B together, the corrugations being concentrically arranged, as shown. The outer edges K and L and M and N of the sheets are welded together, and the edges O P are similarly connected. The edges V W of the sheets E and H are connected to the plates A and B. Small spaces Q and R are thus provided into which the oil can extend from the spaces between the walls A and B of the chamber, whilst there is a free annular air space S between the sheets F and G, so that the outer side of each sheet is exposed to the cooling action of the air.—*June 24th*, 1926.

TELEGRAPHS AND TELEPHONES.

238,512. May 23rd, 1925.—IMPROVEMENTS IN LOADED TELEPHONE AND LIKE LINES, *Western Electric Company, Ltd., of Connaught House, Aldwych, London, W.C. 2.*

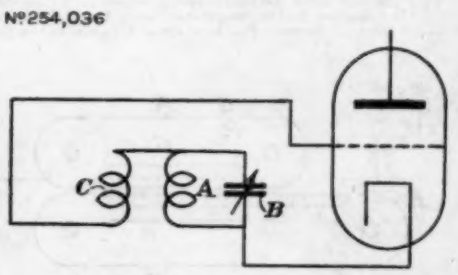
According to this invention, an improved loading unit is employed, the effective inductance of which is a variable quantity, depending upon the frequency of the transmitted waves and diminishing as the frequency increases. By virtue of this diminished inductance, the line tends to transmit the waves of higher frequency with increased velocities, thereby compensating the opposing tendency which normally exists in lines having spaced loading units to delay the higher frequency waves. The



transmission line shown comprises loading units A, between which there are equal sections B of unloaded line, having uniformly distributed constants. The loading units consist of inductance coils, the inductance of which is equally divided between the two sides of the line and two condensers D of equal capacity connected diagonally between the line terminals E F and G and H. The complete unit constitutes a bridge or lattice structure, the general properties of which were described in an article on the "Physical Theory of the Electric Wave Filter," by G. A. Campbell, in the *Bell System Telephone Journal*, Vol. I., No. 2, November, 1922.—*July 1st*, 1926.

254,036. April 7th, 1925.—IMPROVEMENTS IN OR RELATING TO FRAME AERIALS AND THE LIKE, Peter William Willans, of The Cottage, Pattishall, Towcester, Northamptonshire.

This invention relates to frame aerials, particularly those employed in conjunction with a receiving set operating on the well known supersonic principle, and consists in the provision of means whereby interference from stations operating on a wavelength corresponding to the intermediate frequency of such a receiving set is minimised. It has been found that the electromotive force picked up by the turns of a frame aerial from a transmitting station operating on a wave length to which the intermediate frequency amplifier of a supersonic receiver is tuned, is sufficient to cause interference when the frame aerial is connected directly to the amplifier, no matter how well the latter is itself screened. The frame aerial has a solenoid winding of, say, twelve turns, of which the turns A are wound in a right-handed helix and shunted by a condenser B, and the remaining turns C in a left-handed untuned helix. The two sets of six turns are connected together across the grid and filament of a valve.

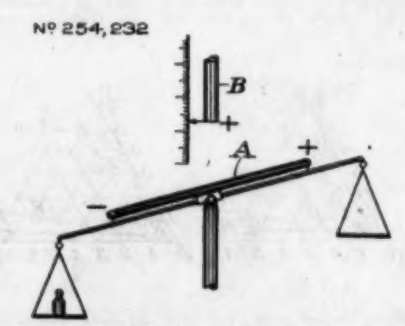


The electromotive force induced in the turns A by any signal is equal and opposite to that induced in the turns C by the same signal. The voltage across the turns A depends upon the value of the condenser B. If the value of this condenser is such that the turns A are tuned to a wave length well below that of a certain transmitting station, the voltage across these turns as a result of signals from such stations is approximately the same as the electromotive force induced in them by such signals, and is therefore approximately equal and opposite to the voltage from the same source across the turns C. The total voltage across the aerial as a result of the transmitting station is therefore approximately zero. At the same time the voltage across the turns A as a result of signals on a wave length equal to that to which the turns are tuned is so large that the voltage across the turns C set up by the same signal is negligible. The aerial transmits impulses to the valve as a result of signals on a wave length to which the turns A are tuned, but does not substantially transmit impulses as a result of signals on a wave length considerably higher than that to which the turns A are tuned.—*July 1st*, 1926.

MEASURING AND TESTING INSTRUMENTS.

254,232. March 8th, 1926.—APPARATUS FOR WEIGHING SMALL MASSES, A. Stock, Im Gehege 4, Berlin-Dahlem, Germany.

This balance is intended for the accurate weighing of very



small masses and is characterised by the fact that the beam is surmounted by a magnet A. Above the magnet there is mounted

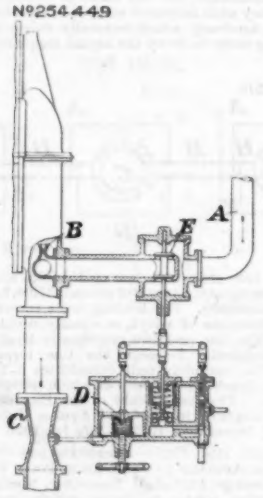
another magnet B, which may be moved to approach or recede from the beam, as indicated, or it may be a fixed electro-magnet with a variable flux. It will be understood that the nearness of the fixed magnet B or the intensity of its flux, if it is of the electromagnetic type, will influence the position of the balance beam. It is claimed that the control of the magnet B provides a very sensitive means of setting the balance.—*July 1st*, 1926.

PUMPING AND BLOWING MACHINERY.

254,449. May 2nd, 1925.—PREVENTION OF SURGING IN BLOWERS, The General Electric Company, Magnet House, Kingsway, London, W.C. 2, and B. Pochobradsky, Goodwood, Lansdown-road, Sidcup, Kent.

The essential idea of this invention is the provision of a controlled by-pass from the delivery side to the suction of the blower. This by-pass is shown at A and terminates in a nozzle B in the suction pipe. The section also includes a Venturi throat C

Nº 254,449



which is connected with the piston D of a servomotor that controls the valve E in the by-pass. If the flow of air through the blower decreases, the pressure in the Venturi throat rises, the piston D rises, and the valve E is opened, so that more air is by-passed from the delivery into the suction. The injector action of the nozzle B then stabilises the flow of air through the compressor.—*July 8th*, 1926.

MACHINE TOOLS AND SHOP APPLIANCES.

254,517. July 9th, 1925.—CASTING SHEET METALS, J. W. Claughton and W. G. Claughton, 378, Oldham-road, Newton Heath, Manchester.

This machine is for the continuous production of cast sheet lead. It comprises two endless metal bands A and B, running round rollers as shown. The bands run between two water-

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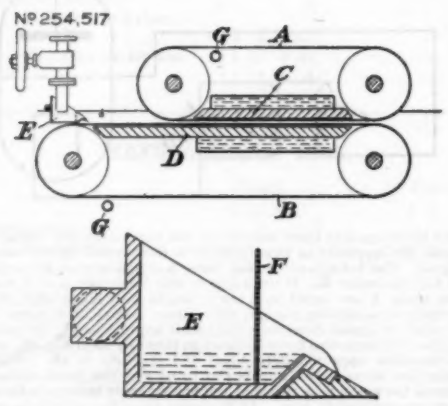


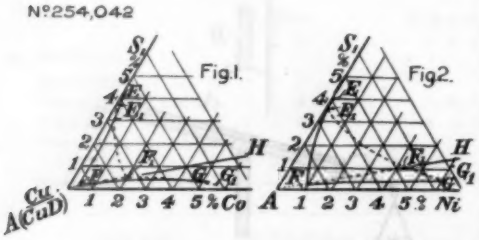
cooled plates C and D, which can be adjusted as to distance apart. Molten lead is supplied from a trough E, of which an enlarged view is given, and flows over a weir on to the travelling band. F is a grating to hold back dross, and G G are burners to heat the bands. The speed of the bands and the rate of flow of lead are so adjusted that the lead is solidified before it leaves the machine.—*July 8th*, 1926.

METALLURGY.

254,042. April 14th, 1925.—COPPER ALLOYS, M. G. Korsunsky, No. 8108, Polk-avenue, Jackson Heights, New York.

This invention consists, in its main aspect, in a process for producing copper alloys amenable to heat treatment,

Nº 254,042



by alloying copper, as the primary component, with a small proportion of silicon together with nickel or cobalt. By way of explanation, equilibrium diagrams of alloys according to the invention are given. Figs. 1 and 2 are equilibrium diagrams of copper-silicon-cobalt and copper-silicon-nickel alloys respectively. Copper is melted in any suitable vessel. To the molten metal is then added from 0·1 to 2·5 per cent. of silicon, and when that is dissolved there is added from 0·4 to 2·5 per cent. cobalt or from 1·0 to 10 per cent. nickel, according to the property desired in the alloy. The ratio between silicon and cobalt or silicon and nickel content should be kept as near as possible to 1 : 4, which ratio is the most economical, as it allows the additions to form the silicide Co$_2$Si or Ni$_2$Si, with no excess of either of the additions being left free, which excess has no value for improving the properties of the alloy by a subsequent heat treatment.—*July 1st*, 1926.

254,442. April 27th, 1925.—MANUFACTURE OF PIG IRON, C. Davies, jun., Republic Building, Youngstown, Ohio.

The aim of the inventor is to produce pig iron low in sulphur content by continuously circulating the slag through the blast-furnace and a separate desulphurising chamber. The slag is drawn off into the chamber A, where the sulphur is oxidised by a

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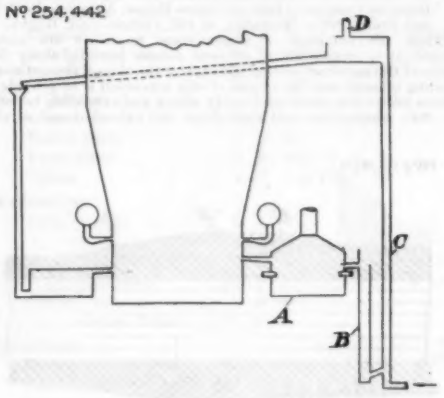

blast of hot air. The resulting sulphur di-oxide is taken away and used for making acid. The slag overflows into a well B, and is raised by an air lift C, supplied with hot air, to a separate D. The heat of the separated air is used in a boiler and the desulphurised slag is returned to the blast-furnace by gravity.—*July 8th*, 1926.

MOTOR CARS AND ROAD TRAFFIC.

254,005. March 25th, 1925.—IMPROVEMENTS IN AND RELATING TO MAGNETO GENERATORS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2; Leonard Griffiths, of 18, Grafton-street, Coventry, and Thomas Woodfield, of 85, Addison-road, King's Heath, Birmingham.

The improved magneto described in this specification is

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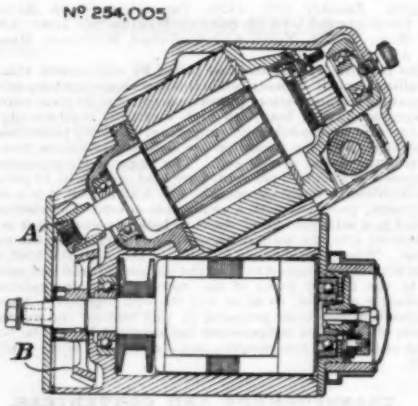

intended mainly for motor cycles, and the special feature of the machine is that the lighting generator unit and the magneto unit are inclined at an angle to each other, as shown, thus enabling a high gear ratio to be obtained by the two bevel wheels A and B mounted on each shaft.—*June 25th*, 1926.

MISCELLANEOUS.

254,098. June 22nd, 1925.—IMPROVEMENTS IN OR RELATING TO ROLLING CONTACTS FOR ELECTRICAL APPARATUS, Vickers Ltd., Ernest Couch Astington, and Edward Thomas Flann, all of Vickers House, Broadway, Westminster.

The rolling contact described in this specification consists of a rigid plate A of metal or other material fitted at or near its

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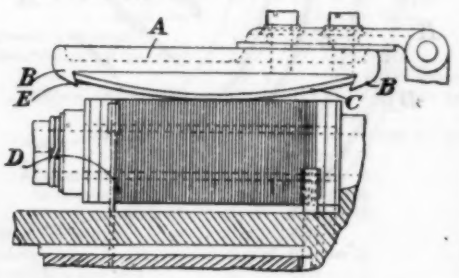
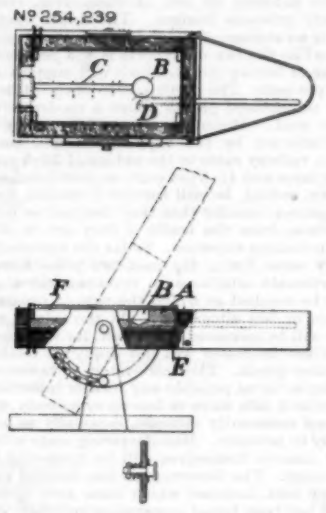


ends with projections B between which a resilient strip C of metal or other material is fitted, the length of this strip being such that, in order that it may be placed between the projections B it must be bowed to the desired curvature for contact with its co-operating surface, which, as indicated, may be constituted by the edges of a series of plates D, with interspersed insulation. The surface of the strip remote from the rigid plate is covered with wire gauze, braid or similar material E, and in order that this may be kept taut without any tendency to creasing as the member rolls over its surface of contact, the gauze is folded over the back of the strip C, and its ends and sides secured together, and, if desired, to the strip, by such means as soldering. Several modifications of the invention are described.—*July 1st*, 1926.

254,239. March 26th, 1926.—APPARATUS FOR TESTING THE VISCOSITY OF FUSIBLE MATERIALS, *Metropolitan-Vickers Electrical Company, Ltd.*, 4, *Central-buildings, Westminster*.

One of the difficulties in measuring the viscosity of molten shellac is that the viscosity of the material continually changes when the shellac is in the molten condition. Therefore it is necessary to maintain all such variables as temperature and duration of heating as nearly constant as possible in order to eliminate errors. The testing apparatus comprises a metal plate A having a receptacle B for the shellac, which is extended by a graduated groove C. D is a thermometer, E an electrical heating element, and F a glass cover. In testing shellac the apparatus is

Nº 254,239



assembled and the current in the heating element is regulated so that the temperature of the plate is maintained at exactly 125 deg. Cent. A sample of two grammes of powdered shellac, which has previously been ground to pass a fifty-mesh screen and to be retained on a sixty-mesh screen, is placed in the receptacle and the glass cover is replaced as quickly as possible. The sample is melted for exactly four minutes with the apparatus in a horizontal position and then the apparatus is tilted to an angle of 60 deg. with the horizontal as shown in dotted lines. The melted shellac then flows into the channel and the time it takes for the shellac to flow to the several divisions of the scale on the top of the metal plate is noted. This rate of flow is a measure of the viscosity of the molten shellac.—*July 1st*, 1926.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY TO WEDNESDAY, AUGUST 11TH.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE—Annual meeting at Oxford.

FRIDAY AND SATURDAY, AUGUST 27TH AND 28TH.

IRON AND STEEL INSTITUTE.—Autumn meeting at Stockholm. For programme see page 125.

WEDNESDAY TO SATURDAY, SEPTEMBER 1ST TO 4TH.

INSTITUTE OF METALS.—Autumn meeting at Liége.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

MR. G. DACRES, M.I. Mech. E., has resigned his position on the sales staff of Hick, Hargreaves and Co., Ltd., of Bolton, to accept an appointment with John Musgrave and Son, Ltd., of Bolton.

MR. ALFRED J. T. TAYLOR, of Toronto, president of the Combustion Engineering Corporation, Ltd., has been offered and has accepted the position of chief executive of the Underfeed Stoker Company, Ltd., of London.

MR. THORNYCROFT DONALDSON, M. Inst. C.E., M.I.N.A., a director of John I. Thornycroft and Co., Ltd., who has been for a number of years in charge of the engineering side of the firm's Southampton works, has now been appointed general manager.

AT the annual meeting of the Wellington Tube Works, Ltd., of Great Bridge, Tipton, Staffs., on July 29th, the chairman reported the resignation of Mr. W. H. Nock, managing director of the company, after forty-five years' continuous service with the company. Mr. Douglas W. Turner, the chairman of the company, was elected managing director to fill the vacancy.

THE INSTITUTION OF ELECTRICAL ENGINEERS: STUDENTS PREMIUMS.—The Council of the Institution of Electrical Engineers has awarded Students' Premiums of the value of £10 each for the session 1925–26 as follows:—W. F. C. Cooper, for his paper on "Some Experimental Work on Relays"; F. J. Lane, for his paper on "A Rotary Converter Automatic Sub-station"; C. T. Melling, for his paper on "The Design of Current Transformers"; H. Pryce-Jones, for his paper on "Electric Winding Engines in Collieries"; and E. Youel, B.Eng., for his paper on "The Thermionic Vacuum Tube."